

UNITED STATES DEPARTMENT OF AGRICULTURE  
SMALL BUSINESS INNOVATION RESEARCH PROGRAM

**TECHNICAL ABSTRACTS**

**Fiscal Year 2002**

**PHASE I**

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**TITLE OF RESEARCH:** ALTERNATIVE GROWTH MEDIUM PRODUCT TO PROMOTE VAM COLONIZATION

**COMPANY:** BITTERROOT RESTORATION INC.  
445 QUAST LANE  
CORVALLIS, MT 59828

**PRINCIPAL INVESTIGATOR:** MR. TIM MEIKLE

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$79,946/6 MONTHS

VAM inoculum is a common specification for large-scale plant production contracts throughout the United States. Currently, VAM inoculation is required for the production of native plant materials in revegetation efforts associated with fire rehabilitation, mine reclamation, conservation plantings, contaminated site cleanup, and other activities. These activities represent a continuous expenditure of public and private funds worth several million dollars annually. A major problem in the revegetation industry is the inability of container growers to produce plants colonized by VAM. Despite the commercialization of VAM inoculum by the biotechnical industry, actual colonization of plants using standard nursery practices has provided consistently low colonization rates. Bitterroot Restoration, Inc. proposes to develop a growth medium product that promotes VAM colonization under standard plant production conditions. Our project will evaluate the influence of alternative growth media components on VAM colonization rates. A series of greenhouse studies will be conducted which systematically contrast VAM colonization rates with recently developed and existing growth media, amendments, and fertilizer types.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Our research will result in a growth medium that integrates VAM inoculum successfully into nursery operations and thereby, enhances the biotechnical industry, increases success rates of revegetation projects, and lowers the cost of projects. Economically, the ability to produce VAM plant materials under nursery conditions will increase the competitive ability and profitability of nurseries through production of a value-added product while decreasing plant material costs of consumers as a result of increased outplanting survival rates. Ecologically, VAM-colonized plants could rest in more complete soil ecosystem restoration with more stable and productive community functioning.

**TITLE OF RESEARCH:** ESTABLISHMENT OF THE FOREST BIOMETRICS INSTITUTE  
- RESEARCH DATABASE

**COMPANY:** FOREST BIOMETRICS  
53 TRESTLE CREEK DRIVE  
ST. REGIS, MT 59866

**PRINCIPAL INVESTIGATOR:** DR. JAMES D. ARNEY

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$69,200/6 MONTHS

The objectives of this project are to: 1. Establish one, standardized research database for long-term records from field studies of all existing growth and yield studies in the Northwestern States currently accumulated and maintained by Dr. James D. Arney. These databases contain 2,846,000 tree records in 20,440 plots representing hundreds of site preparation, planting, brush control, thinning, pruning and fertilization conditions and interactions. They span over fifty years of observation in five western States. 2. Make this research plot database available to other researchers and graduate students wishing to investigate stand dynamics, inter-species competition, growth-mortality relationships and refinements to long-term growth models. 3. Provide the incentive to return copies of all analyses back to this library so that each user generates a net gain to documented knowledge about growth & yield in the Northwest for the benefit of all. In this way even small, short-term analyses may contribute to the overall knowledge in forest silviculture and forest modeling.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

A common, standardized research database will stimulate new research investigation and testing of alternative growth models by graduate students, faculty and other forest researchers. These new studies will contribute to the Library and to publish knowledge about forest dynamics and growth model architecture. It will provide analytical field data to investigate alternative silvicultural regimes being suggested by current State watershed and wildlife regulations.



**TITLE OF RESEARCH:** ENVIRONMENTALLY SAFE POLYMERIC WOOD PRESERVATIVES

**COMPANY:** NOVAFLUX TECHNOLOGIES, INC.  
1 WALL STREET  
PRINCETON, NJ 08540

**PRINCIPAL INVESTIGATOR:** DR. RICHARD F. STOCKEL

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Environmentally safe wood preservatives based on polybiguanides (PBGs) chemistry will be developed. Building on our preliminary data, the novel PBG molecular structure will be tailored to possess multiple functions (anti-fungal, insecticidal, ion-chelating and hydrophobicity) to perform as a broad spectrum wood preservative. Three molecular sites will be used to tailor the PBG molecule including: backbone, end-caps and associated anions. Total of 18 PBG compounds will be synthesized and tested using the standard soil-block method. The synthesis method is simple and versatile, and starting compounds are inexpensive. The main tasks include: synthesis of well-defined 18 structures, development of methods for uniform compound penetration into wood, testing effectiveness as wood preservatives and analysis of data to define the most effective molecules for the Phase II study. Preliminary evaluations of our PBGs structures by Dr. Jeffrey Morrell identified two critical modifications leading to highly effective wood preservation performance, namely: chelation and hydrophobization. PBGs made with cystamine (a chelating segment) in the backbone and with hydrophobic character proved to be the most promising. These results constitute the foundation for the proposed 18 PBG structures. Only commercially available modifiers will be used to develop a cost-effective wood preservative.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Successful PEG molecular structures with the best overall potential as wood preservatives will be identified with the corresponding mechanisms elaborated. Based on the results, developing integrated formulations and in-situ interfacial synthesis for incorporation into wood will be included in future studies. The criteria for selecting a successful wood preservative are: biocidal activity against relevant microorganisms, blocking enzymatic and chemical reaction leading to wood decay, toxicity, leachability, cost effectiveness, impact on the environment and life cycle. The PBG-based preservatives are expected to capture a portion of the yearly sales of wood preservatives that is estimated around \$3.5 billion.

**TITLE OF RESEARCH:** FIELD EVALUATION OF A MICROPUMP-BASED  
MULTICOMPONENT AGGREGATION PHEROMONES  
DISPENSER

**COMPANY:** MED-E-CELL  
10633 ROSELLE STREET  
SAN DIEGO, CA 92121

**PRINCIPAL INVESTIGATOR:** DR. HENRI J. R. MAGET

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$79,696/6 MONTHS

Pheromones are an important part of insect management; they are ecologically more acceptable than insecticides. Insect management often requires the release of multiple aggregation pheromones (generally 2 or 3 different semiochemicals). Currently, multiple diffusion controlled bubble caps or vials are required; their questionable field performance as a result of lack of reliability and lack of control of the emission rates, is also compounded by the need for multiple devices. The proposed investigation is aimed at comparing the field performance of a novel micropump-based dispenser with that of conventional bubble caps and vials, in attracting bark beetles. Delivery accuracy and reliability of this novel dispenser have already been demonstrated, in 2001, in the laboratory and in the field, albeit only for the release of an aqueous solution of antiaggregation pheromone (MCH). The object of this test will be to assess the opportunity to extend the technology to aggregation pheromone blends, released from a single solution.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

By demonstrating field efficacy for aggregation and antiaggregation pheromones (an experiment is underway in Utah and Arizona, using MCH, under a USDA-SBIR-1 grant) in Phases I and II, the dispenser could become the "workhorse" for research, monitoring and insect management, in forestry. A demonstration of its all-purpose usefulness (eventually including mating disruption) would represent a sizeable commercial business opportunity, attractive to investors.

**TITLE OF RESEARCH:** WOOD-STRAND EROSION CONTROL MATERIAL

**COMPANY:** FOREST CONCEPTS, LLC  
1911 SW CAMPUS DRIVE, #655  
FEDERAL WAY, WA 98023

**PRINCIPAL INVESTIGATOR:** DR. JAMES H. DOOLEY

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$79,824/6 MONTHS

The proposed project will create an innovative erosion control material for forest and wildlands applications that performs or exceeds the functionality of agricultural straw while addressing known limitations. Agricultural straw is widely used for erosion control in projects throughout the world. Recent events and new knowledge challenge the advantages believed to be held by agricultural straw, particularly when used in highway, wildland and forest applications. From an ecological perspective there is a desire to use indigenous materials for erosion control at road decommissioning, trail building and other construction projects on wildland, recreational forest and production forest areas. Phase I activities will include disciplined engineering design and experimentation to specify physical properties for a straw analog that meets or exceeds the performance of certified agricultural straw. Research quantities of a "best solution" wood-based product will be produced prior to the end of the project. A proof-of-concept experiment will yield statistically valid data for testing the hypothesis that the resulting wood-based straw alternative does in-fact meet or exceed straw functional performance.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Wood-based straw analog products can be manufactured from small-diameter timber harvested from forest health or fuel-reduction programs. It may also use fast-growing agroforestry species. Production of the product provides a new source of income and jobs for timber-dependent communities and forest landowners. Manufacturing will involve 5 to 25 community-scale facilities. With economic impact considered, the project will create and support up to 600 living/wage jobs in rural and timber-dependent communities. Production technologies are relatively simple and capital requirements are more modest than production of oriented strand board, laminated veneer lumber and other small timber products.

**TITLE OF RESEARCH:** BIOLOGICAL CONTROL OF SUBTERRANEAN TERMITES

**COMPANY:** TERMITE 2000  
3002 W. MERCER LANE  
PHOENIX, AZ 85029

**PRINCIPAL INVESTIGATOR:** DR. KIRK A. SMITH

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$77,700/6 MONTHS

Termites represent a significant threat to humans, not only as a result of financial losses due to property damage, but also with respect to their capacity to compromise the environment and adversely affect human health. Current methods of controlling termite infestations rely on the use of toxic insecticides, which are extremely detrimental to human health. The goal of the proposed research is to develop a system that is capable of effectively eradicating termite infestations while eliminating the use of toxic chemicals. To meet this goal, we will accomplish the following Specific Aims: 1) cultivate a self-regulating biological control 'system' (insect-killing nematodes in the genera *Steinernema* and *Heterorhabditis* and their symbiotic bacteria, *Xenorhabdus* and *Photorhabdus*, for elimination of subterranean termites; and 2) develop a delivery system that consistently delivers a defined quantity of variable nematodes directly to the site of infestation. By integrating the design of the delivery system with the use of the nematodes, we will specifically address problems of consistency and effectiveness that have plagued previous efforts to develop similar systems. We plan to continue to expand the testing localities and capabilities of this system during Phase II, and then commercialize it for distribution during Phase III.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

There is a far-reaching need for a system that consistently delivers an environmentally friendly mechanism for termite control. The Termite 2000 System is expected to provide for the consistent reproducible delivery of a self-regulating biological control system designed for the expressed purpose of eradicating termite infestations. Once eliminated, the Termite 2000 System can be used to inject biological agents that repel termites to prevent re-infestations. Additionally, the delivery system is capable of delivering potentially toxic substances, e.g., termiticides, in such a manner that the distribution is controlled and unintended exposure minimized.

**TITLE OF RESEARCH:** FORMATION OF A STRUCTURAL CORE MATERIAL FROM RECYCLED FIBER

**COMPANY:** WEST MOUNTAINVIEW INTERNATIONAL LLC  
5803 TEXAS DRIVE  
VANCOUVER, WA 98661

**PRINCIPAL INVESTIGATOR:** DR. JOHN S. FUJII

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$70,000/6 MONTHS

Prior attempts to develop and commercialize a lightweight fiberboard panel have faltered due to lack of an industrially robust manufacturing process or significant limitations in end use performance properties. In this Proposed Phase I project, two continuous forming methods will be researched for producing a three-dimensional structural core material with properties suitable for widespread applications. Said core will be incorporated into a composite sandwich panel whose properties will be characterized by finite element analyses and ASTM test methods. Prototype decorative hardwood-veneered panels will be converted from core samples for preliminary commercial feasibility evaluation. A proposed path forward for Phase II research and development and early commercialization will be formulated following a critical analysis of the subject feasibility research.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

It is anticipated that results of this Phase I research will validate the feasibility of manufacturing a lightweight panel substrate in a cost effective manner and with product end use performance characteristics unavailable in earlier lightweight fiberboard panels. Direct commercial participation of prospective manufacturing and marketing strategic partners is anticipated following a favorable feasibility result.

**TITLE OF RESEARCH:** PASSIVE MICROWAVE SENSOR TECHNOLOGY FOR GROUND OR AIRBORNE DETECTION OF VISIBLE, OBSCURED, OR SUBSURFACE HOTSPOTS TO ACCURATELY DETECT PRECISION HELI-TANKER AND HOT SHOT CREW RESPONSE

**COMPANY:** CUSTOM MANUFACTURING & ENGINEERING, INC.  
2904 44TH AVE. N.  
ST. PETERSBURG, FL 33714

**PRINCIPAL INVESTIGATOR:** MR. DAVID J. ARFT

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$69,998/6 MONTHS

With record-breaking disastrous wildfires along with the human toll fighting them, no real-time technology is available to hot shots or heli-tanker suppression crews to easily detect and pinpoint water/retardant suppression on latent or lingering hot spots which are often obscured by dirt, smoke or dust. We propose to generate functional requirements of a microwave radiometer handheld sensor and airborne sensor, develop a brightness temperature radiative model to investigate the microwave thermal emission characteristics from below surface hot spots as a function of operation frequency, conduct outdoor radiometer measurements of burning materials to aid in validating the model, and develop a preliminary design for a handheld and/or microwave airborne sensor. Initially, we will leverage/use a CME/Raytheon developed passive microwave radiometer to conduct brightness temperature measurements of certain forest fuel sources to support the selection of an optimum detector frequency. Military-related microwave technology advancements enable the feasibility of developing small airborne, ground-based, and even handheld microwave sensors. Even in heavy smoke, a handheld, passive microwave sensor would allow hotshot supervisors to prioritize suppression crews to the most threatening sites. A helicopter-mounted sensor would allow pinpoint drop of their precious suppression cargo; and hot shot crews could easily detect subsurface roots still burning but hidden. Our team proposes a multi-pronged approach to significantly improve the performance and safety of wildfire suppression crews.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The development of passive microwave sensor technology to reduce the risk of and better control wildfire on forest land. Leveraging our sensor technology developments for military applications, this hotspot detection technology will aid the Forest Service and affiliated National Interagency Fire Center (NIFC) organizations. A lightweight, passive microwave hotspot sensor would 1) improve firefighter safety and reduce manpower needed to manually monitor post-flame hotspots; 2) enable real-time detection of subsurface or/obscured hotspots; 3) provide ground supervision the ability to prioritize/direct hot shot crews to the most threatening latent hotspots; 4) provide heli-tanker, tanker/pumper trucks and ground crews with real-time hotspot intelligence not available from aerial or spaceborne platforms; 5) counter IR imaging's susceptibility to smoke and dust. This technology has worldwide application potential. Future advanced sensor fusion with IR technology could strengthen fire aviation services.

**TITLE OF RESEARCH:** MODIFICATION OF HIGHLY ACTIVE XYLANASE BY DIRECTED EVOLUTION

**COMPANY:** rPEPTIDE  
245 UNIVERSITY CIRCLE  
ATHENS, GA 30605-3721

**PRINCIPAL INVESTIGATOR:** DR. NEERAJ DATTA

**TOPIC AREA:** FORESTS AND RELATED RESOURCES

**GRANTED AMOUNT:** \$71,430/6 MONTHS

An *Orpinomyces xylanase* gene (XynA) has been cloned, sequenced, and overexpressed in a readily fermentable production host (*E. coli*). Fermentation and down-stream processing have been established. XynA is most active and stable at temperatures of 50°C to 60°C and at a pH ranging from 5.8 and 7.5. The enzyme works well for industrial bleaching of paper pulp when the temperature and pH are within these ranges. Furthermore, the enzyme significantly improves animal (swine & poultry) weight gain and feed conversion when the feed has NOT undergone high temperatures and moisture pelleting. Most pulp bleaching processes are run at high temperature and pH, and a substantial percentage of chicken feeds are pelleted at high temperature (85-100° C); conditions that are not favorable to XynA. To fully capture the potential of the current xylanase, we propose to genetically alter the XynA gene through accelerated directed molecular evolution/breeding to produce mutant enzyme derivatives with higher thermostability and tolerance to more alkaline pH's. During Phase I of the project, we will focus on development and fine-tuning of mutation and screening procedures. In Phase II, mutant XynA enzymes with improved thermostability, with improved pH profiles, and isolates with both improved properties will be identified. Mutant enzymes will be tested for their compatibilities with fermentation and down-stream processes and their field performance under industrial conditions.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Mutant xylanases will be generated by error-prone PCR technology and identified with plate screening methods. Mutant xylanases will be identified that retain high levels of activity at elevated temperatures with improved thermostability. Similar mutants will be identified that work well between pH 6.0-9.0. Enzyme derivatives that have both enhanced thermal stability/activity and alkaline pH will also be obtained. The enzymes will be selected for their ability to optimally enhance existing processing conditions for pulp bleaching and animal feed manufacturing. Ultimately, the technology will be used for improving other industrial enzymes such as cellulases, phenolic esteases, mannanases, amylases, and pectinases to suit the needs of industrial applications.

**TITLE OF RESEARCH:** USE OF MTR KINASE INHIBITORS AS SELECTIVE  
HERBICIDES AND ANTI-SENESCENCE AGENTS

**COMPANY:** INTERLAB  
151 DEL PRADO  
LAKE OSWEGO, OR 97035

**PRINCIPAL INVESTIGATOR:** DR. KENNETH A. CORNELL

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$78,800/6 MONTHS

The development of new herbicides continues to be an important agricultural concern in the U.S., where hundreds of millions of pounds of plant pesticides are used annually. The search for new agents that have low toxicities to non-target organisms (especially humans) requires the identification and exploitation of biochemical differences between plants and other higher eukaryotes. The enzyme methylthioribose (MTR) kinase serves as one such biochemical difference since its presence is restricted to plants, and some bacterial and protozoal species. MTR kinase inhibitors specifically interrupt methionine recycling from S-adenosylmethionine (AdoMet) used in the synthesis of polyamines. In doing so, they also limit the AdoMet available for the synthesis of the plant hormone ethylene, which controls the senescence of flowers and fruits. Here, we propose to evaluate MTR kinase inhibitors for their potential herbicidal activities as well as the ability to retard floral senescence. In this Phase I application, we will characterize the effects of MTR analogs against recombinant *Arabidopsis thaliana* MTR kinase, and correlate this to effects on germination and seedling growth of *A. thaliana* and select agriculturally important crops and weeds. We will also examine the ability of these analogs to prolong the shelf-life of two economically important cut-flowers, roses and carnations.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

If successful, this research will lead to the development of new non-toxic herbicides with broad agricultural and ornamental applications since they specifically inhibit methionine salvage in plants. In addition, with their potential to inhibit ethylene formation, these agents may find ready use in the floral industry as a replacement for the environmentally toxic additive silver thiosulfate used to prolong flower shelf-life.



**TITLE OF RESEARCH:** COMMERCIAL DELIVERY OF THE BLUE ORCHARD BEE  
FOR ORCHARD POLLINATION

**COMPANY:** INTERNATIONAL POLLINATION SYSTEMS - U.S.A.  
6035 W. SCHOOL COURT  
VISALIA, CA 93291

**PRINCIPAL INVESTIGATOR:** DR. STEPHEN S. PETERSON

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$47,447/6 MONTHS

The European honey bee is responsible for 80% of the insect pollination in the U.S. While this bee is an excellent generalist pollinator, research has shown that certain crops may be better pollinated by other bee species. The blue orchard bee has been shown to be a superior pollinator of apples, almonds, cherries and other crops. This bee is currently available from a handful of suppliers, but the low supply has meant that only backyard gardeners buy them at the current prices. In order to deliver this species as a pollinator to commercial agriculture, we need to grow a large supply of these bees. We propose to work cooperatively with personnel at ARS, Oregon State University and growers to begin increasing a large population of these bees on meadowfoam, a winter annual oilseed crop, grown in Oregon. Meadowfoam growers will benefit from improved pollination and reduced honey bee costs. We will also demonstrate that these bees can be managed for commercial pollination of several commercial crops grown in California such as almonds, cherries, and plums.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The pollination system developed by will deliver superior pollination compared to honey bees, at a price that is competitive with honey bee rentals for several crops including, cherry and plum. This pollination system will obtain surplus bees from meadowfoam and sustain or build them in orchard crops. This method will not depend upon trapping wild bees and deliver a reasonably priced, sustainable, environmentally sound, safe pollinator to agriculture.

**TITLE OF RESEARCH:** TRANSPOSABLE ELEMENT -BASED, SITE-SPECIFIC RECOMBINATION SYSTEM FOR PLANTS

**COMPANY:** PHYTODYNE, INC.  
2901 S. LOOP DRIVE, BUILDING 3, SUITE 3515  
AMES, IA 50010

**PRINCIPAL INVESTIGATOR:** DR. DAVID A. WRIGHT

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$79,750/6 MONTHS

Site-specific recombination (SSR) is a powerful tool for studying gene function, and it offers great promise for harnessing the biosynthetic capacity of plants to produce compounds of commercial value. Two limitations to the use of SSR in plants are 1) the low frequency by which it occurs and 2) the difficulty in delivering enough DNA to produce a desired recombination event. Phytodyne Inc. proposes to overcome these limitations through the use of transposable elements. Excision of DNA transposons increases SSR more than 1000-fold, thereby overcoming the inherently low frequencies of homologous recombination in plants. cDNA generated by retrotransposons - transposable elements that replicate by reverse transcription-is highly recombinogenic. Retrotransposons can be modified to carry any sequence of interest and to synthesize cDNA at high levels. Every plant cell, therefore, can be converted into a 'cDNA factory' to overcome limitations of DNA delivery. This proposal seeks to use retrotransposon cDNA to correct defective marker genes by SSR. Among the marker genes tested will be those from which DNA transposons are actively excising to increase recombination frequencies. Completion of these experiments will provide the foundation for a transposon-based, site-specific recombination system for altering gene sequences from a variety of important crop species.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The goal of this proposal is to create an efficient system for site-specific recombination in plants. Such a system currently does not exist; success will provide an important enabling technology for the plant biotechnology sector. Phytodyne intends to license this technology to other agricultural biotechnology companies and to carry out contracted site-specific recombination.

**TITLE OF RESEARCH:** CHILE PEPPER PRODUCTION AND PROCESSING IN THE MIDWEST

**COMPANY:** CAPSIGEN  
W14089 SELWOOD DRIVE  
PRAIRIE DU SAC, WI 53578

**PRINCIPAL INVESTIGATOR:** DR. JAMES JAY MOONEY

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$18,500/6 MONTHS

The relatively short growing season in the Midwest presents a problem for farmers who wish to capitalize on the growing demand of chile peppers products. Chile pepper is a warm-season crop and grows best in the long frost-free season in the Southwest. There is a lack of productive varieties available to Midwest farmers. The objectives of this research are to evaluate experimental chile pepper hybrids for production and processing potential in the Midwest, and to determine seed production capability. The goal is to determine the feasibility of growing CapsiGen chile pepper hybrids for large-scale chile pepper production in the Midwest. Six hybrid chile pepper selections will be evaluated in the field for plant growth habit, disease and insect tolerance, maturity, yield, heterosis, and fresh use and processing characteristics. Hand-pollinations will be made in the field to determine outdoor seed production capability.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

High yields of early maturing varieties are necessary for Midwest chile pepper production. The chile pepper hybrids to be tested in this research may have yield and processing characteristics that are necessary for large-scale production in the Midwest. Productive varieties would allow Midwest farmers to support a processing industry in the Midwest, and would provide them with a profitable crop rotation alternative.

**TITLE OF RESEARCH:** DEVELOPMENT OF SAFER, EFFECTIVE, FUNGICIDE FORMULATIONS

**COMPANY:** SUMMERDALE, INC.  
4249 MARINER LANE  
OKEMOS, MI 48864

**PRINCIPAL INVESTIGATOR:** DR. ROBERT D. COLEMAN

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$47,700/6 MONTHS

Fungicides are used on millions of acres of agricultural crops, to control disease and increase yield harvest. However, current products have high chronic toxicity and many are suspected human carcinogens and/or teratogens and may not be re-registered under the Food Quality Protection Act. Summerdale, Inc. has showed that selected fatty acids and other compounds have efficacy as fungicidal active ingredients (Als), against a wide range of pathogens. Earlier work on herbicidal formulations has also shown synergistic combinations between certain fatty acids and an amendment. The economics for effective application rates of Als at this stage of development appears attractive. If Phase I efficacy is demonstrated, a strategic partner may wish to participate. This proposed work would develop predominantly natural compounds and will meet grower criteria for shifting to a new product. A range of fatty acid species and other compounds will be tested individually and with other compounds, to examine possible synergistic relationships. Extensive laboratory and greenhouse trials on potatoes, soybeans and peanuts will be conducted prior to extensive field trials (Phase II), to determine effective application rates, emulsification systems and adjuvants.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Summerdale, Inc. has signed a licensing agreement with a strategic partner to manufacture key components for natural agricultural products. Fatty acid-based fungicide formulations would represent another important product line for the partner and/or it's sub-licensee(s). The worldwide fungicide market is about \$5.5 billion (approximately 20% of the world pesticide market). Synthetic chemicals, many derived from petrochemicals, are used in about 99% of all fungicides. Hence, very few natural chemicals are currently in use. Fungicide usage (U.S.) is growing at a faster rate than any other pesticide and is projected to increase by 24.5% from 2000 to 2005.

**TITLE OF RESEARCH:** DEVELOPMENT OF NUTRIENT MANAGEMENT SYSTEM  
FOR ENVIRONMENTALLY SOUND TERRESTRIAL  
SEAWATER AGRICULTURE

**COMPANY:** SEAPHIRE INTERNATIONAL  
4455 EAST CAMELBACK ROAD, SUITE B-200  
PHOENIX, AZ 85018-2874

**PRINCIPAL INVESTIGATOR:** DR. ZHONGJIN LU

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$79,553/6 MONTHS

Terrestrial seawater agriculture that utilizes pure seawater or seawater-based aquaculture effluents as irrigation sources to produce crops along barren coastal deserts, would play a potential role in supply of sustainable food to feed the world's ever-increasing population. The feasibility of seawater agriculture depends first on finding salt tolerant plants and second on developing matched agronomic technology. Among 1300 halophytes (naturally salt-tolerant plants) collected worldwide, *Salicornia bigelovii* Torr. has been identified as the most promising one for seawater agriculture. This plant can produce high yields of edible oil, protein meal, vegetable tips, forage, and fiber on seawater irrigation. Its improved varieties as a seawater agricultural oilseed crop are under release by USDA. Matched technology of seawater irrigation has also been established to effectively prevent salt accumulation in the rhizosphere. However, terrestrial seawater agriculture in practice has been challenged by nutrient management problems that arise from leaching and runoff of applied fertilizers through frequent irrigation on sandy soils where it occurs. The consequence of nutrient leaching includes not only greatly increasing the overall production cost due to fertilizer inefficiencies, but also potentially causing eutrophication of ground water. Therefore, our Phase I research attempts to find a best-suited way to control nutrient losses in seawater agriculture. The research is proposed to reveal the minimal and cost-effective plant requirements for nutrients that are not supplied by irrigated seawater and to investigate the feasibility of foliar application of required nutrients in the form of fertilizers.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The integrated approach of the minimum and cost-effective input of nutrients and foliar feeding of required nutrients would help control leaching and runoff losses of applied fertilizers in terrestrial seawater agriculture. Since seawater already provides plants with certain essential nutrients, anticipated results of our Phase I research will find out the minimal and cost-effective plant requirements for nutrients that are supplied in very limited concentrations in seawater, such as primary macronutrients (nitrogen and phosphorus) and micronutrients (iron, manganese, zinc, copper, and molybdenum). This research will also reveal the feasibility of foliar feeding in seawater agriculture, through investigating *S. bigelovii* responses to foliar applications of N, P, and micronutrients. The combined results would serve as a basis of developing the matched fertilization technology for terrestrial seawater agriculture of environmental and economic benefits.

**TITLE OF RESEARCH:** SUPPRESSION OF PLANT PESTS AND DISEASES, AND  
HUMAN PATHOGENS, BY FOOD WASTE  
VERMICOMPOSTING

**COMPANY:** OREGON SOIL CORPORATION  
19712 SOUTH SOUTHBEND ROAD  
OREGON CITY, OR 97045

**PRINCIPAL INVESTIGATOR:** DR. KEITH E. FLETCHER

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$79,592/6 MONTHS

The efficient production of high value horticultural vermicomposts, using automated high technology continuous-flow reactors, and their beneficial use in greenhouse and field applications, have been demonstrated convincingly by Oregon Soil Corporation and at OSU with positive results, with previous USDA/SBIR Phase I and Phase II support. For successful commercial development of vermicomposts, further critical research questions relating to the effects of vermicomposting on plant pests and human pathogens still remain to be answered. These include: 1) The degree and extent of suppression of plant diseases by use of vermicomposts in greenhouse and field. 2) The assessment of suppression of arthropod (insects and mites) attacks on plants by use of vermicomposts in greenhouse and field. 3) The extent of suppression of attacks by plant parasitic nematodes by use of vermicomposts in the field. 4) The proportion of weed seeds in food wastes destroyed by vermicomposting. 5) The amount and timing of suppression of human pathogens in food wastes by vermicomposting.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The critical remaining barriers to full and profitable commercial development and production of vermicomposts, produced in high technology continuous-flow automated reactors by Oregon Soil and other companies, are the need for scientific research data on the objectives summarized above. If it can be demonstrated that widespread and significant suppression of plant pests and human diseases is achieved by vermicomposting organic wastes, this would provide a major sales promotion boost to extend the marketing vermicomposts and assure public acceptance and use of the medium.

**TITLE OF RESEARCH:** IDENTIFICATION OF TRANSCRIPTION FACTORS INVOLVED  
IN RUBBER BIOSYNTHESIS

**COMPANY:** MENDEL BIOTECHNOLOGY, INC.  
21375 CABOT BLVD.  
HAYWARD, CA 94546

**PRINCIPAL INVESTIGATOR:** DR. ROBERT A. CREELMAN

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Mendel Biotechnology, Incorporated has identified approximately 1700 transcription factors (TFs) from *Arabidopsis thaliana*. We have proprietary methods which will allow us to determine the interaction of TFs with any promoter of interest. The primary objective of this Phase I SBIR grant is to identify *A. thaliana* transcription factors which can activate Guayule (*Parthenium argentatum*) promoters of genes in the isoprenoid biosynthetic pathway. We currently have access to Guayule genes which are in the isoprenoid biosynthetic pathway leading to rubber or to other isoprenoids: 3-hydroxy-3-methylglutaryl-CoA reductase, farnesyl pyrophosphate synthase, geranyl geranyl pyrophosphate synthase, and sesquiterpene cyclase (kindly provided by Dr. Katrina Cornish, Western Regional Research Center, USDA-ARS). Dr. Cornish will also provide the promoters for rubber synthase when it becomes available.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

In Phase I, we will identify *A. thaliana* TFs which can interact with promoters from *P. argentatum* isoprenoid genes. Phase II will consist of transforming Guayule with these TFs to determine if rubber yield can be increased without compromising rubber quality. There are strategic and economic incentives to develop a renewable, United States-based supply of natural rubber. Dependable rubber supplies are endangered by factors such as pathogen attack, diminished acreage, increased global demand, and changing political climates. For these reasons, commercialization and natural rubber production from domestic crops is in the best short- and long-term interests of the United States.

**TITLE OF RESEARCH:** MANAGEMENT OF TURFGRASS DISEASES AND THATCH BY STREPTOMYCES AND FUNGI

**COMPANY:** INNOVATIVE BIOSYSTEMS, INC.  
121 SWEET AVENUE  
MOSCOW, ID 83843-2386

**PRINCIPAL INVESTIGATOR:** DR. MARK A. ROBERTS

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (BIOLOGY)

**GRANTED AMOUNT:** \$79,995/6 MONTHS

Problems associated with turfgrasses include thatch accumulation and fungal diseases such as dollar spot, brown patch, and Pythium crown/root rot. Excessive thatch accumulation, in turn, exacerbates disease prevalence and degrades turf quality. Approximately 40 million acres are planted in turf in the U.S. About 20% of all fungicides used in the U.S. are applied to turfgrasses, which is greater than that applied to any other single horticultural or agronomic crop. Due to the high usage rate of pesticides and the intimate contact humans have with turfgrass, safer alternatives are required. We propose research utilizing a synergistic approach towards biological control of turf diseases, enhanced thatch biodegradation with ligninolytic *Streptomyces* and white-rot fungi, and iron mobilization on a commercial iron-humate product with active siderophore-producing *Streptomyces*. A portion of the research will address the feasibility of formulating a value-added biological through compatibility experimentation of the de-thatch microorganisms with *Streptomyces lydicus* WYEC 108, a commercial biological control agent. A stand-alone lignin-degrading *Streptomyces*/fungus formulation with biological control, de-thatch, and iron-mobilizing properties will also be developed. Research will include compatibility testing of *Streptomyces* with white-rot fungi and fungicides, microbial population dynamics, siderophore assays and in vivo de-thatch and challenge experiments.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Availability of an effective biological control and de-thatch agent will allow residential owners and golf course managers alternative IPM or stand-alone strategies for highly managed turf. At the completion of the Phase I research, we will determine the feasibility of a synergistic approach to biological disease control, de-thatch, and iron mobilization for turfgrass health. Providing an effective thatch biodegradation formulation will lead to short-term commercialization as a value-added product with a current biological control product, while long-term commercialization potential lies in formulation of a stand-alone biocontrol/dethatch biological.



**TITLE OF RESEARCH:** PREDICTING LOCAL DISEASE RISK INDICATORS WITH MULTI-SCALE WEATHER, LAND & CROP DATA

**COMPANY:** SUBTERRANEAN RESEARCH, INC.  
P.O. BOX 1121  
BURLINGTON, VT 05402-1121

**PRINCIPAL INVESTIGATOR:** DR. DONNA M. RIZZO

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (ENGINEERING)

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Fungal and bacterial diseases in crops are so strongly dependent on specific environmental conditions that the risk of disease can be predicted from microclimate data such as temperature, relative humidity, solar radiation, wind speed, and surface wetness duration (SWD). Despite the evidence that disease risk modeling provides guidance for efficient spray utilization with no added risk of yield loss and is an improvement over calendar-based spray programs, these systems have failed to achieve widespread use. The inconvenience and expense of local monitoring of key variables such as SWD are factors preventing these models from being widely used. This proposal is for the development of web-based Geographical Information System (GIS) tools that ultimately can be used to map disease risk at fine spatial and temporal scales. The Phase I project is a proof-of-concept that involves the development of two Artificial Neural Networks (ANNs) to estimate key environmental disease risk factors at local scales from local and regional GIS information, weather station data, and site specific sensing data. An extensive dataset collected at Geneva, New York, as well as regional geographic and weather data, will be used to conduct and assess the research.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

This project, which leads to improved disease risk factor predictions, has immediate and long-term benefits. Immediate benefits include overcoming the difficult spatial and temporal scaling problem that has frustrated previous modeling attempts, where complex 3-D atmospheric and meso-scale models were applied with limited success. Web-based GIS allows information to be readily disseminated, provides for easily incorporating improvements, is applicable to other sites, and provides a coupling interface to other decision tools, data, and mathematical models. Longer term benefits include widespread adoption of disease risk modeling in pesticide spray programs, leading to reduced cost and improved sustainable management practices.

**TITLE OF RESEARCH:** POLYASPARTATE CLATHRATE GELS FOR TURFGRASS  
MANAGEMENT AND ENVIRONMENTAL PROTECTION

**COMPANY:** AQUERO COMPANY, LLC  
1710 WILLOW CREEK CIRCLE, SUITE 150  
EUGENE, OR 97402

**PRINCIPAL INVESTIGATOR:** DR. ANDREW S. MOUNT

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (ENGINEERING)

**GRANTED AMOUNT:** \$68,000/6 MONTHS

The purpose of this SBIR phase I project is to demonstrate the utility of gelling particles made from cross-linked polyaspartate for controlled availability of both nutrients and pesticides in a turfgrass model system. Polyaspartate gelling materials: 1) fully biodegrade and have growth promoting degradation products, 2) can carry guest molecules within "clathrate "cages" of the polymer network when dry, releasing their guest molecules when hydrated, 3) readily absorb 20 to 100 times their weight in aqueous fluid, keeping water in contact with the plant. In the proposed studies, diammonium phosphate, ammonium nitrate and 2 nematicides: avermectin and Ditera™ will be loaded separately into the gelling materials. The release of the active agents will be characterized by chemical tests, soil leaching experiments and turfgrass bioassays. It is anticipated that novel biocompatible, clathrate gels will be widely used for promotion of plant growth and slow release of pesticides in a variety of agricultural settings.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Slow release of nutrients and pesticides by polyaspartate gels benefits both agriculture and the environment. The active agents remain in the root zone which decrease the need for high application rates thereby enhancing efficacy and lowering the cost to the consumer. Water quality will also improve as the quantity of agricultural chemicals added to the environment declines. Polyaspartate gels offer novel benefits such as biodegradability and release of growth-promoting degradation products. These materials and other polyamino acids can be produced economically for specialty as well as commodity markets.

**TITLE OF RESEARCH:** FLOW CONTROL AND OPERATION MONITORING SYSTEM FOR INDIVIDUAL SPRAY NOZZLES

**COMPANY:** CAPSTAN AG SYSTEMS, INC.  
101 N. KANSAS AVENUE  
TOPEKA, KS 66603

**PRINCIPAL INVESTIGATOR:** MR. GRAEME W. HENDERSON

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (ENGINEERING)

**GRANTED AMOUNT:** \$80,000/6 MONTHS

This project addresses the increasing demands and need for precise control and reliability in agrochemical application. The ultimate goal of this project is a single-nozzle monitoring and control technology and device. The device will allow individual nozzle resolution on flow rate and spray droplet size. The device will also provide, either in conjunction with control or simply as a driver-alert system, individual monitoring of proper nozzle operation. Often, drivers cannot see all spray nozzles on a large boom or they are fully engaged in driving a wide, fast-moving vehicle over rough terrain. Individual nozzle communication will be achieved using current CAN bus systems which are commercially used on spray application vehicles. This research effort will initially focus for techniques for reliable, low-cost, robust flow sensing and actuator monitoring. Pressure, acoustic, vibration and vortex-shedding techniques will be investigated with spray nozzles. Potential interference from vehicle noise, vibration and electrical emissions will be determined. Signal processing requirements for low-cost sensors will be determined. At-nozzle microprocessor requirements for communication, sensor signal analysis and actuator control and will be determined. The results from Phase I will be used in Phase II to design a prototype system and implement it on commercial sprayers.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

This project is designed to lead directly to product design. The envisioned product is a single-nozzle control monitoring unit for agricultural spray applications. The unit will integrate well into existing Capstan products, which already provide means for nozzle control. Initially, the monitoring capabilities of the unit will allow more efficient, reliable and safe agrochemical application and less driver fatigue. Eventually, the unit will provide the highest possible spatial resolution in agrochemical application.

**TITLE OF RESEARCH:** SUNLIGHT INDEPENDENT CROP CANOPY REFLECTANCE SENSOR

**COMPANY:** HOLLAND SCIENTIFIC  
5011 SOUTH 73RD STREET  
LINCOLN, NE 68516

**PRINCIPAL INVESTIGATOR:** DR. KYLE H. HOLLAND

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (ENGINEERING)

**GRANTED AMOUNT:** \$79,096/6 MONTHS

In order to realize on-the-go site-specific management of nitrogen for agricultural and turf grass operations, the need for a rapid, robust methodology for measuring plant nutrient deficiencies is required. Crop canopy reflectance sensors that are currently available are limited primarily by the need for adequate ambient light (sunlight) in order to make the required measurement. The proposed research will develop and prototype a new sunlight independent light sensor which will measure the color spectra reflected from plant canopies and/or soil. The sensor will be integrated into a network of sensors that are connected to a central data collection and control instrument. Data collected from the sensors will be utilized in determining the nutrient requirements of the plant material or for determining the organic matter content of bare soil. The new sensor will overcome the sunlight irradiance limitations by actively irradiating the plant or soil with an integrated light source. The new sensor will be able to make measurements in full sun or in complete darkness.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Our proposed sensor design will provide improved performance over existing crop canopy sensor technology by eliminating the reliance on fair weather sunlight conditions. Since the sensor is not limited by the amount of ambient light, the sensor can be operated outside of daylight hours even in complete darkness. This technology could have a significant impact on nitrate-nitrogen leaching and run-off by determining when crops and turf require nitrogen fertilizer. Coupling this type of sensor with fertilizer rate control systems will reduce over-application of N that has resulted in elevated levels of N in ground and surface waters.

**TITLE OF RESEARCH:** A REVERSE VENTURI ATOMIZATION CHAMBER

**COMPANY:** ARENA PESTICIDE MANAGEMENT  
3412 LAGUNA AVENUE  
DAVIS, CA 95616

**PRINCIPAL INVESTIGATOR:** MR. RUSSELL STOCKER

**TOPIC AREA:** PLANT PRODUCTION AND PROTECTION (ENGINEERING)

**GRANTED AMOUNT:** \$49,720/6 MONTHS

Spray drift is a significant issue facing agricultural applicators throughout the United States. Up to half of the crop production materials applied are delivered to the crop site by air. This method is highly valued by the farmer and contributes to American agricultural productivity. However, material that drifts off-site is of concern. Material not applied to the target is a financial loss for the farmer and a liability for the applicator if damage occurs. Off-site drift also represents an environmental liability, particularly as habitat and water quality concerns demand more and larger buffer and/or no-spray zones. The proposed reverse venturi atomization (RVA) chamber is a potential strategy to mitigate the problem of off-site drift. Current practice delivers liquid material through a nozzle, under pressure, and utilizes air shear for at least a portion of the atomization. Atomization creates a range of droplets with those in the  $<200\mu$  range, known as fines, particularly susceptible to off-site drift. As air speed increases, so does the effect of air shear on the atomized droplets, resulting in larger droplets shattering into fines. By creating spray droplets within the RVA chamber, we propose to minimize the effect of air shear, reduce the overall percentage of droplets in the  $<200\mu$  range, and ultimately reduce the potential for material applied by air to drift off-site.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

We expect to demonstrate that the reverse venturi atomization chamber (RVA) will reduce the percentage of spray droplets in the  $<200\mu$  range. The reduction of these fine droplets, which are prone to off-site drift, will be a significant benefit to the agricultural spray industry, as well as the public and the environment. RVA chamber will demonstrate a significant advance in application technology.

**TITLE OF RESEARCH:** HYDRODYNAMIC PRESSURE PROCESSING USING THE SAFE, HIGH-OUTPUT TENDERIZER

**COMPANY:** FOSTER-MILLER, INC.  
350 SECOND AVENUE  
WALTHAM, MA 02451-1196

**PRINCIPAL INVESTIGATOR:** MR. JOHN D. WILLIAMS

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$79,961/6 MONTHS

The innovation addressed in this proposal is a low-cost, high-throughput, meat processing technology that substantially improves meat tenderness while killing bacteria. Based upon a developmental concept known as hydrodynamic pressure processing (HDP), the proposed innovation will use intense, underwater shock waves to significantly improve the tenderness of boneless cuts beef, pork and poultry. And like HDP, this device will dramatically reduce the number of microbial pathogens such as *Escherichia coli* O157:H7 (*E. coli*) and *listeria*, as well as those that contribute to spoilage, such as the pseudomonads. Unlike HDP, however, the Foster-Miller device will avoid the use of explosives in favor of an inherently safe pressure generation technology. In addition, the proposed innovation will operate continuously rather than in batch mode, making it far better suited to the large throughput of modern meat processing plants. The Foster-Miller design will also feature a hydrodynamically tuned containment vessel to maximize the effectiveness of the shock wave. The effort described in this proposal would benefit the USDA's Animal Production and Protection initiatives by enabling the development of the hydrodynamic pressure process using the safe, high-output tenderizer (HDP-SHOT).

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The proposed innovation would provide a cost effective means to tenderize boneless cuts of beef, pork, and chicken. In addition, HDP-SHOT also kills bacteria and increases shelf life. Other viable commercial opportunities include the sterilization of liquid food products, metal forming, and sewage treatment.

**TITLE OF RESEARCH:** DETECTION OF FMDV BY ANCHORING TRANSITIONS OF LIQUID CRYSTALS

**COMPANY:** PLATYPUS TECHNOLOGIES, LLC  
505 S. ROSA ROAD, SUITE 62  
MADISON, WI 53719

**PRINCIPAL INVESTIGATOR:** DR. BARBARA A. ISRAEL

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$79,753/6 MONTHS

Platypus™ technology is a novel, platform technology for the detection of molecular interactions. It is based on the exquisite sensitivity of liquid crystals to nano-scale features on surfaces. It can be used for the detection of a wide range of target molecules. Its advantages are: simplicity, rapidity, freedom from secondary amplification systems, enzymes or labels, the use of visible light as the direct readout, fieldability and the ability to design multiplex assays. We have demonstrated the potential application of our technology to diagnostic virology using polymeric materials with surface features on the 50-100 nm scale produced by e-beam lithography. In this proposal, we will determine the feasibility of developing the technology for the detection of smaller viruses, such as foot and mouth disease virus (FMDV), whose sizes are below the current limits of routine materials fabrication based on e-beam lithography. We propose to develop new types of surfaces based on nanostructured gold films with topography matched to that of the size of FMDV. We will functionalize these surfaces with a single chain antibody specific for FMDV in such a way that liquid crystals will uniformly anchor on these surfaces. We will also demonstrate that FMDV will bind to these surfaces in such a way that it will give rise to easily visualized changes in the appearance of liquid crystals anchored on these surfaces.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The long term goal of this research is to develop a rapid, simple and sensitive assay for foot and mouth disease virus (FMDV). This assay will be designed for use in the field without need for extensive sample preparation, expensive equipment or labile reagents. The future customers will include government agencies charged with investigation of outbreaks. The technology can be adapted for the detection of other viruses. Platypus Technologies LLC will partner with a larger company for marketing and distribution of its viral diagnostic products.

**TITLE OF RESEARCH:** A SOMATIC CELL COUNT SENSOR FOR THE DAIRY INDUSTRY

**COMPANY:** EN 'URGA INC.  
1291-A CUMBERLAND AVENUE  
WEST LAFAYETTE, IN 47906

**PRINCIPAL INVESTIGATOR:** DR. YUDAYA SIVATHANU

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

This Phase I SBIR project will evaluate the feasibility of utilizing mid-infrared absorption spectroscopy for continuously monitoring the somatic cell count in milk. The somatic cell count in milk is widely used as a predictor of the health of a cow. If the somatic cell counts could be monitored on a daily basis, the onset of mastitis can be identified and the effective treatment for the sick cows started immediately. The two innovative features of the proposed technique are (1) a high frequency lead selenide array to obtain the mid-infrared absorption coefficients of milk at multiple wavelengths, and (2) a deconvolution algorithm to quantify the somatic cell count in milk in the presence of interference from other constituents. During the Phase I project, mid-infrared absorption signature will be obtained for a period of two weeks from calibrated milk obtained from many cows. These will be used to develop and evaluate a chemometrics algorithm that can quantify the somatic cell count. A multi-wavelength sensor will be designed and evaluated during the Phase II project. At the conclusion of the Phase I and Phase II project, a reliable somatic cell sensor will be developed for immediate commercialization.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Mastitis is the most costly dairy cattle disease. In herds without an effective mastitis program, approximately 40% of the cows are infected in an average of two quarters, leading to an estimated loss of \$200 per cow per year. Somatic cell counts are closely correlated with the prevalence of mastitis in cows. Currently, somatic cell counts in cows are obtained monthly. If the dairy farms were able to monitor the somatic cell counts of individual cows on a daily basis, at least 70% of the revenue loss due to mastitis can be recovered. Therefore, the commercial potential of a reliable somatic cell sensor is high.



**TITLE OF RESEARCH:** A DECISION SUPPORT TOOL TO INVESTIGATE EMERGING COMPLEX PROBLEMS IN THE DAIRY INDUSTRY

**COMPANY:** AGRICULTURAL INFORMATION MANAGEMENT, INC.  
1317 WILLOW CREEK DRIVE  
NAMPA, ID 83686

**PRINCIPAL INVESTIGATOR:** DR. MARK L. KINSEL

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$78,500/6 MONTHS

The purpose of this project is to augment the DairyORACLE simulation program with additive and structural changes that will facilitate its use as the "infrastructural" model for problem solving in the dairy sector. Producers as well as researchers are constantly proposing changes in inputs to the dairy operation. A producer must select from an ever increasing array of products for use on their dairy, where the definition of "product" might include a disease control program as well as a typical physical input unit. In a similar manner, researchers need to know the potential economic value of a new product or management practice in a dairy production system. The products and ideas from both groups often have multidimensional impacts (production, reproduction, survivability, etc.) on a dairy operation, and thus have complicated economic consequences. They can affect not only the average profits on a dairy farm, but also the variability of that profit. The changes to DairyORACLE will: 1) facilitate the operation of the model, 2) describe the epidemiological attributes of infectious disease, and 3) provide a suite of sophisticated economic analysis tools that can be used as a basis for decision making.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

It is anticipated that the changes in DairyORACLE will make it an important tool for disease management on dairies. It is also envisioned that researchers will use DairyORACLE as a "starting point" to investigate the economic consequence of a proposed product or concept in dairy production. Instead of "reinventing the wheel", DairyORACLE can be used as the base program on which they can add components relevant to their particular area of study. The addition of the DairyORACLE internet "community" will also provide an opportunity for broader use and feedback which is anticipated to speed the evolution of this management tool.

**TITLE OF RESEARCH:** DEVELOPING MICROENCAPSULATED MEDICINES TO PROTECT HONEY BEES

**COMPANY:** BETTERBEE, INC.  
8 MEADER ROAD  
GREENWICH, NY 12834

**PRINCIPAL INVESTIGATOR:** MR. ROBERT A. STEVENS

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$70,000/6 MONTHS

Honey bees are a crucial part of U.S. agriculture through their pollination activities and the value of hive products. Nevertheless, they are suffering from parasitic mite diseases, new pests, and potentially from antibiotic resistant pathogens. Protecting honey bee stocks from these threats requires integrated and multi-pronged approaches. Moreover, consumer demands are for reduced usage of harsh chemicals in association with foods, etc. The proof of concept of the use of botanicals or organic acids to help in protecting honey bees is established through microencapsulated menthol fed in sugar patties to overwintering honey bees in their hives. This proposal is to test similarly "softer" chemicals that are known to have potential for suppression of parasitic mites or other pathogens (American Foul Brood). Testing will determine target animal safety and efficacy (non-lethal doses to honey bees but suppress incidence of disease). Feeding trials will determine which materials, when fed to honey bees, become systemic and are safe. The safe materials will be microencapsulated and fed to honey bees in laboratory trials to determine efficacy and acceptance by bees with a view to commercialization of new honey bee medicaments.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The project expects to turn up several botanicals or organic acids that suggest themselves as relatively safe as ingested medicaments for use in honey bee hives against parasitic mites and possibly antibiotic resistant American Foul Brood. The project will explore the potential for use and commercialization of microencapsulated formulations of selected materials as registerable medicaments for the beekeeping industry.

**TITLE OF RESEARCH:** NUTRITIONAL APPLICATIONS OF KERATINASE ENZYME

**COMPANY:** BIORESOURCE INTERNATIONAL, INC.  
840 MAIN CAMPUS DRIVE, SUITE 3560  
RALEIGH, NC 27606

**PRINCIPAL INVESTIGATOR:** DR. NASSER ODETALLAH

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$71,200/6 MONTHS

During a series of innovative studies in the Department of Poultry Sciences at North Carolina State University (NCSU), *Bacillus licheniformis* PWD-1 was isolated and identified as a unique feather-degrading bacterium. Subsequent research elucidated the broad-spectrum keratinase enzyme, the gene encoding keratinase, and potential applications of keratinase in animal feed. These results form the basis for six U.S. and international patents. Scaled-up production of keratinase in a 150-liter fermentor in the NCSU Fermentation Facility was achieved. Based on these and other results, BioResource International, Inc. (BRI) was founded to serve as the exclusive licensee of the six keratinase patents from NCSU and commercialized this technology for the efficient application of heratinase to animal feed. To translate these preliminary findings into a commercially viable technology platform, it is necessary to validate and optimize the use of keratinase in animal feed. Thus, the objectives of this study are: 1) to determine the nutritional feasibility of keratinase enzyme as an additive in poultry feed; and 2) to determine the economic feasibility of formulating poultry feed with the enzyme.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Application of keratinase enzyme to poultry feed will directly benefit the agricultural and animal industries by enabling a more efficient conversion of feed into meat by improving the digestibility of the feed ingredients. Eight billion broiler chickens are produced in the U.S. each year. More than 14 million tons of poultry starter feed are produced for these birds. Preliminary studies showed that supplementing the starter feed with keratinase at g/kg could significantly improve the growth of young chicks over the chicks on a marginally protein-deficient diet. The proposed project is to confirm the preliminary data and further the research on other animals and fish. If confirmed, poultry industry alone will have the potential to save \$300 million feed cost, while the new keratinase will have a market of \$350 million.

**TITLE OF RESEARCH:** PATHOGEN CONTROL FOR LIVE POULTRY PRODUCTION

**COMPANY:** LYNNTECH, INC.  
7610 EASTMARK DRIVE  
COLLEGE STATION, TX 77840

**PRINCIPAL INVESTIGATOR:** DR. ANTHONY GILETTO

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Contamination of poultry and poultry products by Salmonella and other pathogens is a serious worldwide problem, causing an excess of \$1.4 million in lost productivity, medical expenses and poultry production costs. To control the risks associated with consumption of pathogens on poultry products, Federal processing plant inspection protocols (also known as the 'three strikes' rule) have been enacted. Many commercial poultry processors employ the use of disinfectants and antimicrobials at some point during growout; however, the growing number of plants failing the third strike period has led to an urgent need to limit Salmonella contamination and infection within live production facilities. This proposal describes a method for intervening in the pathogen infection and fecal shedding cycle by providing a new liner disinfectant. The application of this potent yet safe organic, dry material directly onto contaminated litter between flocks and during growout can help growers eliminate Salmonella and other pathogens from the litter. The treated litter will minimize colonization of pathogens derived from new chicks and reduce feces transmission between birds. Phase I will focus on demonstrating disinfection efficacy and understanding manufacturing requirements of the disinfectant while Phase II efforts will center on commercial field demonstration of the technology.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Development of these new solid antimicrobial compounds for use as poultry litter amendments will reduce the spread of pathogens within poultry rearing houses, thereby reducing microbial load at processing plants. The end result is a safer food product and an economic boost to a significant sector of U.S. production agriculture. A manufacturer and distributor for the envisaged product have already been identified and have signed related technology evaluation agreements. Successful reduction of pathogens in broiler litter will lead to testing and evaluation in other food animal production industries (i.e., beef cattle feedlots, swine production farms).

**TITLE OF RESEARCH:** SUSTAINED-RELEASE DELIVERY SYSTEMS FOR SEMIOCHEMICALS/KAIROMONES FOR CONTROL OF FIRE ANTS

**COMPANY:** BIOGUARD RESEARCH & DEVELOPMENT, INC.  
8220 WEST GAGE BLVD., SUITE 742  
KENNEWICK, WA 99336

**PRINCIPAL INVESTIGATOR:** DR. DOMINIC A. CATALDO

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$77,491/6 MONTHS

BioGuard proposes to develop an improved sustained-release delivery system for volatile chemicals that can be used to attract or repel the imported fire ant and/or its predators. In conjunction with USDA/ARS in Gainesville, Florida BioGuard will implement the development and testing of sustained-release delivery systems for a series of semiochemicals and kairomones to improve control measures for repelling fire ants in broad area applications, improve existing baits by addition of attractants, and the sustained delivery of kairomones to improve the performance of the parasitic phorid fly. Sustained-release delivery systems to be developed under this SBIR project will be designed to control the release and subsequent air or soil concentrations of repellents and attractants related to fire ant control strategies. The systems to be developed will be based on polymeric sustained-release delivery systems that BioGuard has commercialized over the last decade and/or been working on with USDA/ARS under CRADA #58-3K95—834 to release volatile chemical attractants for the German cockroach (*Blattella germanica*).

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Phase I is designed to test BioGuard's ability to apply current research being conducted on slow release of volatile chemicals to attract German cockroach and release of pesticides to semiochemicals/kairomones to control fire ants. Success of this project would allow improvements to: 1) all existing imported fire ant bait products by differential attraction of IFA versus other species; 2) allow for the creation of new products for broad area protection (repellents); 3) protection of areas with endangered/threatened species by allowing for spot control with repellents; and 4) improve efficacy of phorid fly for control of the IFA.

**TITLE OF RESEARCH:** CLOSED-LOOP WASTEWATER/ODOR TREATMENT SYSTEM FOR FOOD ANIMAL WASTES

**COMPANY:** TECHSAVANTS, INC.  
211 E. ILLINOIS STREET, LOWER LEVEL  
WHEATON, IL 60187

**PRINCIPAL INVESTIGATOR:** DR. DONALD O. JOHNSON

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$79,996/6 MONTHS

The project addresses problems related to odors from swine production operations and to storing/treating of large volumes of water used to wash swine production structures. With the industry trend toward larger confined operations, the industry is facing increased public pressure to eliminate doors and reduce the risk of spills from large holding tanks and lagoons. Currently, wastes are treated in days-to-weeks; this project's goal is to reduce treatment time to hours-to-days using sonication (sound energy), technology currently used for wastewater treatment in the foundry, environmental and petroleum industries. This project will evaluate sonication as a cost-effective method to decontaminate and deodorize liquid swine wastes. The project's objectives are to: 1) determine levels to which sonication can clean solids-filtered wastewater; 2) define the time and energy required to reach "cleaned" levels; and 3) evaluate sonication's impact on wastewater nutrients. To meet the objectives, four tasks are planned: 1) obtain and filter solids from hog-farm wastes; 2) fabricate a laboratory-scale sonication test unit; 3) conduct a test program to evaluate frequency, power and time on the liquid wastes treatment; and 4) Analysis of data and reporting. Phase I will provide data for Phase II "Development of the Closed-Loop Wastewater/Odor Treatment System".

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Phase I results will validate the ability of sonication to deodorize and decontaminate liquid wastes while not destroying nutrients. Process-related data on frequency, power, and time will provide baseline information for Phase II development and field testing of the closed-loop system. Phase II data will include collection of process operating information, system economics, life cycle testing, and an in-place evaluation of the innovative paper filter technology. Successful demonstration of the system will lead to fast-track commercialization. The system will be designed for scale-up, thus it can be used in small operations as well as CAFOs.

**TITLE OF RESEARCH:** PRODUCTION OF HIGH-GRADE GERMLINE CHIMERAS FOR GENETIC MANIPULATION OF CHICKENS

**COMPANY:** ORIGEN THERAPEUTICS  
1450 ROLLINS ROAD  
BURLINGAME, CA 94010

**PRINCIPAL INVESTIGATOR:** MS. CHRISTINE MARGARET MATHER

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

The aim of the project is to use embryonic stem (ES) cell technology to create chickens that produce novel therapeutic protein in eggs. Somatic and germline chimeras can be generated by injecting freshly isolated cells from stage X embryos into recipient embryos of the same stage. Efficiency is reduced when chicken ES cells are injected. Our specific aim is to increase the frequency of high-grade and germline chimeras by maximizing the incorporation of ES cells. In Phase I, chicken ES cells expressing green fluorescent protein (GFP) will be used as a reporter system to evaluate (a) the suitability of stage VIII and IX recipients embryos from premature eggs and (b) the relationship between the duration in culture of the cES cell line and its ability to contribute to the germline. The embryos will be incubated using Origen's established surrogate shell system, modifying the conditions to suit the premature eggs if necessary. The options that give the maximum number of viable somatic chimeras and the highest level of germline transmission will be adopted in Phase II to establish flocks of chickens that deposit novel proteins in their eggs.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

A hen manufactures several grams of protein daily in egg white and yolk. Origen will harness this protein production system by creating genetically engineered chickens using ES cell technology. Chimeras will be generated using cES cells carrying human genes coding for a range of therapeutic proteins, including monoclonal and polyclonal antibodies. Within 20 weeks of hatching, these novel proteins will be deposited in eggs from high-grade chimeras, and germ-line chimeras will founder transgenic flocks enabling large-scale, cost-effective production of high-quality therapeutic proteins.

**TITLE OF RESEARCH:** RAPID, ENVIRONMENTALLY SAFE APPROACH FOR DISPOSAL OF CARCASS WASTE

**COMPANY:** LYNNTech, INC.  
7610 EASTMARK DRIVE  
COLLEGE STATION, TX 77840

**PRINCIPAL INVESTIGATOR:** DR. G. DUNCAN HITCHENS

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

This Phase I 'proof-of-concept' project concerns the development of a thermophilic bioreactor approach for on-farm disposal of unprocessed poultry carcass waste. Recently approved groundwater and air quality restrictions have limited or eliminated the further use of most conventional carcass disposal methods, including incineration and pit burial. Composting is currently the only available means of disposal in many areas, but this method has recently drawn significant criticism and litigation due to severe odor generation, unmanageable populations of insects and rodents, and the tremendous potential for environmental release of pathogens. Our preliminary studies have indicated that rapid, controlled, high-temperature biodecomposition of animal carcass waste can be achieved via a newly selected thermophilic culture(s) of bacteria. Importantly, virtual odorless disintegration of poultry carcass biomass was accomplished at temperatures known to effectively destroy poultry pathogens. In Phase I, we will fabricate a bench scale-reactor to characterize the critical parameters needed for continuous, rapid degradation of poultry carcasses. Chemical characterization of the system will be performed, including the composition and partitioning of the final products into the solid and liquid phases. Phase II will involve development of lyophilized seed cultures and construction of a full-scale, automated prototype for evaluation under commercial conditions.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The thermophilic bioreactor for rapid poultry carcass decomposition will be designed for on-farm use at typical turkey and broiler grower or layer operations. This simple, ecologically friendly technology will 1) reduce the growing environmental burden of confined feeding operations, 2) be automated, simple to operate/repair, and easily incorporated into existing grower operations, and 3) allow for control of odor, pathogens and populations of disease vectors. Additionally, further processing of the solids and liquids phases may allow for increased economic value in the form of non-potable rinsing water and/or disease free inorganic nutrients for field application.



**TITLE OF RESEARCH:** RAPID PESTICIDE RESIDUE ANALYZER

**COMPANY:** REAL-TIME ANALYZERS, INC.  
87 CHURCH STREET  
EAST HARTFORD, CT 06108-3728

**PRINCIPAL INVESTIGATOR:** DR. STUART FARQUHARSON

**TOPIC AREA:** ANIMAL PRODUCTION AND PROTECTION

**GRANTED AMOUNT:** \$79,944/6 MONTHS

In 1999 the FDA reported that as much as 1% of food brought to market may have contained pesticide residues exceeding EPA tolerance levels (sub part-per-million concentrations) set for safe consumption. The uncertainty in this value is due to the long analysis times (hours/sample) that limit the amount of food actually analyzed. Inspectors need an analyzer that can provide comprehensive analysis in minutes to ensure compliance and increase distribution of safe food, as well as animal feed. We propose a surface-enhanced Raman (SER) based analyzer to satisfy this need by detecting pesticide residues on food and feed below tolerance levels in 5 minutes or less. This will be accomplished through the use of a new nanocomposite material (metal-doped sol-gel) that selectively enhances analyte specific Raman signals reversibly and reproducibly. Phase I will employ combinatorial chemistry to coat 96-well micro-plates with varying sol-gel compositions and properties. Each micro-plate well will be screened for chemical selectivity and SER-activity using eight of the most commonly detected pesticides. This series of pesticides also represents several chemical classes. Feasibility will be demonstrated by added pesticides to food samples, and selectively detecting them after minimum sample preparation (e.g., organic extraction).

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Phase II will fully develop the method by building a SER spectral library of 100 or more pesticides, designing the SER-active material into sampling systems for discrete food inspection or continuous monitoring at a produce receiving station. During Phase II, a hand-held prototype will be field tested at a regional inspection station. In addition to the proposed application, improvements in sensitivity would allow the analyzer to be used for pesticide analysis in contamination waters (groundwater, lakes, etc.). Simple modifications to the sol-gel chemistry would also allow the detection of chemical warfare agents, and the analysis of drugs and drug metabolites.

**TITLE OF RESEARCH:** PREDICTING PESTICIDE TOXICITY VIA QSAR AND ENSEMBLES

**COMPANY:** MEDINTEL  
313 N. CALIFORNIA STREET  
HELENA, MT 59601

**PRINCIPAL INVESTIGATOR:** MR. TIMOTHY LEE NAGEL

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Chemical numbers are rising dramatically with limited hazard assessment testing completed. Vast majorities of compounds have not undergone even basic toxicity testing despite FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act), TSCA (Toxic Substance Control Act), and increased safety standards via FQPA (Food Quality Protection Act) legislation. Manufacturer testing costs routinely reach \$10 to \$50 million for a single compound. There is simply not enough time or money to complete test batteries for even a portion of today's registered compounds. Necessary alternatives involve developing computational hazard assessment models, however, such modeling is restricted. Computational developments require methodologies for accurate quantitative predictions, utilization of only limited sparse experimental data, and applicability to a wide variety of compound classes & biological endpoints. This research tests feasibility for novel mathematical chemistry tools to meet computational and pesticide hazard assessment challenges via: 1) Software calculators that estimate non-empirical structural descriptors (QSAR, Quantitative Structure-Activity Relationships) for pesticides directly from structure to augment sparse experimental data sets and avoid measurement costs; 2) An innovative hierarchical hQSAR™ strategy to select the descriptors most relevant for hazard endpoints; 3) Model building algorithms that use sophisticated machine-learning tools based on artificial neural networks (GEFS™, Genetic Ensemble Feature Selection) to accurately predict toxicity.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Prior research has demonstrated our ability to accurately predict acute aquatic toxicity of benzene derivatives with ensemble (GEFS™) & hQSAR™ techniques 70% closer to perfect correlation than standard QSAR methods, 20% over standard mathematical data reduction & other neural networks, and ≥90% laboratory tests. We anticipate similar results for pesticides and plan extended applications to a wide variety of pesticide compound classes and biological endpoints that comprise FIFRA, FQPA & other prudent testing. Integration and further automation in Phase II and III R&D will provide exceptional hazard assessment tools for a current \$5 billion market that will double in five years.

**TITLE OF RESEARCH:** IN-SITU APPLICATION OF NEAR INFRARED REFLECTANCE SPECTROSCOPY TO SOILS

**COMPANY:** VERIS TECHNOLOGIES  
601 N. BROADWAY BLVD.  
SALINA, KS 67401

**PRINCIPAL INVESTIGATOR:** MR. COLIN CHRISTY

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$71,022/6 MONTHS

Recent environment developments have created increased demand for in-field measurement of soil constituents. Soil carbon measurements are needed to study carbon sequestration and measurements of soil nitrogen could be used to manage and minimize the leaching of nitrates into the ground water. Near infrared reflectance spectroscopy is an optical method that has shown good results in the laboratory for measuring soil carbon, soil nitrogen and other soil constituents. If this method could be applied in-situ without substantial loss of measurement accuracy, then a rapid field analysis of soil would be possible. Previous attempts have used designs that were prone to interference from dust and mud. This research proposes a method of performing in-situ optical measurements through a sapphire window. The sapphire, which has good optical qualities and is extremely durable, is pressed against the soil to maintain a smooth and consistent sample geometry. The window will be used to measure soil spectra in both a stationary mode and a non-stationary mode. Multivariate statistical analysis will then be used to correlate the spectra to levels of various soil constituents including carbon and nitrogen. These results will be compared to a similar analysis of spectra acquired in the laboratory.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The objective of this research is to demonstrate the ability to use in-situ near-infrared spectroscopy to estimate total carbon, total nitrogen, soil water content and CEC with a coefficient of determination not less than 0.80. If these measurements prove feasible, then further research could ultimately lead to the development of an on-the-go sensor system to investigate the spatial distribution of soil constituents. Furthermore, such a system could be applied to carbon sequestration and nitrogen fertilizer management.

**TITLE OF RESEARCH:** PHYTOREMEDIATION OF ARSENIC-CONTAMINATED SOIL

**COMPANY:** EDENSPACE SYSTEMS CORPORATION  
15100 ENTERPRISE COURT, SUITE 100  
CHANTILLY, VA 20151-1217

**PRINCIPAL INVESTIGATOR:** DR. MARK P. ELLESS

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Arsenic is a contaminant of soil in orchards, farms, and other sites in the United States and other countries, posing significant health risks to humans and animals. Currently, there is no cost-effective method to clean arsenic-contaminated soils. The main objective of this research is to test the feasibility of using a recently discovered arsenic-hyperaccumulating fern (*Pteris vittata*) to remove arsenic from contaminated soils. Preliminary data demonstrate that when grown on an arsenic-contaminated soil, this fern achieves a shoot arsenic concentration more than 200 fold higher than that of any other plant species tested, and concentrates arsenic in its shoots at levels more than 50 times the soil concentration without the addition of chelating agents or other soil amendments. In this research, we will determine the biomass production and arsenic uptake of *P. vittata* grown in an arsenic-contaminated farm, and demonstrate significant arsenic removal by this fern from soils collected from four other agricultural sites. We will also assess the effects of soil pH, arsenic species, agronomic factors such as shading and plant density, and targeted soil amendments on the efficiency of arsenic phytoextraction by the fern.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The anticipated result of this research is a demonstrated arsenic phytoextraction technique that can form the basis for follow-on research and cost-effective cleanup of specific arsenic-contaminated soils associated with agricultural and horticultural activity.

**TITLE OF RESEARCH:** A SOIL SAMPLING MECHANISM FOR ON-THE-GO  
ANALYSIS AND MAPPING OF PH AND OTHER PROPERTIES

**COMPANY:** VERIS TECHNOLOGIES  
601 N. BROADWAY  
SALINA, KS 67401

**PRINCIPAL INVESTIGATOR:** MR. PAUL E. DRUMMOND

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$61,888/6 MONTHS

The use of GPS-aided technology to apply inputs site-specifically has a significant potential to improve the use of fertilizers, lime, and other materials. One of the main factors limiting the effectiveness of this technology is the problem of accurately assessing the input requirements of the field. In the most common approach, soil samples are acquired on a 2.5 acre grid pattern, sent to a laboratory for analysis, and various interpolation methods are applied to the sample results in order to predict the values for the entire field. Studies have shown that soil properties often have spatial variability greater than 2.5 acres, however the costs of sampling and lab analysis preclude denser sampling. A promising approach to this problem is to use devices that measure soil properties on-the-go more intensively than 2.5 acres/samples. One such sensor was prototyped by Purdue University for sensing soil pH. It demonstrated that soil pH could be successfully measured in-situ using combination, ion-selective electrodes. For this device to be viable, research must be conducted to create a soil sampling mechanism that can acquire soil in a wide variety of soil conditions and at commercially acceptable operating speeds.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Currently, in excess of \$10 billion of fertilizers and lime are applied to U.S. fields (NASS). Growers are becoming increasingly aware of the variability within these fields, yet they also recognize that spatial variabilities of properties may exceed what 2.5 acre grid sampling can identify. Many are waiting to adopt precision practices until improvements are made in the technology. Once a soil-sampling mechanism is developed, on-the-go pH measuring can become a reality. Research into the feasibility of using combination, ion-selective electrodes to measure potassium and nitrogen levels in situ is currently underway, which would require a similar sampling mechanism.

**TITLE OF RESEARCH:** COMPUTERIZED RANGELAND LEVEL III MONITORING SYSTEM

**COMPANY:** LAND EKG, INC.  
6085 BROWNING LN.  
BOZEMAN, MT 59718

**PRINCIPAL INVESTIGATOR:** MR. CHARLES ORCHARD

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$79,828/6 MONTHS

Phase 1 project will research and establish feasibility of integrating three independent, state of the art, rangeland assessment/monitoring techniques. This will produce a standardized, ecologically comprehensive, paper based Level III rangeland monitoring system for use on public and private lands. Project will be collaborated with USDA ARS research scientists. Subsequent research will determine technical feasibility to employ automatic digital recording capabilities with assembled software to speed data entry and management. The U.S. contains more than 300,000,000 hectares of rangeland producing annual estimated forage values of \$5.9 billion for agricultural producers, and numerous other economic, ecological, and societal values. The chief commercial use of rangelands in the United States is livestock grazing to produce food, fiber, and draft animals. Serious degradation can and has resulted in the irreversible loss of the capacity of rangelands to produce commodities and satisfy ecological and social values. High value is placed on sustaining and improving resource "function" for future generations. Concerns have been raised regarding the "health" of rangeland ecosystems, and current scientific data, from multiple evolutionary rangeland monitoring techniques, can not determine whether rangelands are improving or degrading. Research and development for an optimal, standardized monitoring system is economically, socially, and environmentally important.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

This project will provide public and private land stewards the capability to monitor rangelands. Resulting system will provide more standardized ecological measurements and significantly reduce time and costs associated with field data collection, management, and analysis, while increasing steward's ability to monitor and sustainably manage rangeland ecosystems. This assembled rangeland monitoring system will allow approximately 900,000 U.S. land stewards to use a standardized soil and vegetative monitoring tool. This will stimulate documentation and improved analytical and management capabilities for increased economic sustainability, rangeland production, and ecological health, as well as provide abilities to comply with statutory and regulatory monitoring requirements.

**TITLE OF RESEARCH:** USER-FRIENDLY FLUORESCENT FIELD TEST FOR PESTICIDES

**COMPANY:** CHEMMOTIF, INC.  
60 THOREAU ST., #211  
CONCORD, MA 01742

**PRINCIPAL INVESTIGATOR:** DR. AMY E. STEVENS MILLER

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$69,999/6 MONTHS

In this Phase I SBIR program, a novel, user-friendly field sensor strip for the detection of pesticides will be developed. Based upon a multi-layer design to create a highly visible fluorescence upon exposure, it is non-instrumental, single-use test strip that can be deployed and interpreted in an easy and straightforward manner. Upon exposure to organophosphorus pesticides in water, a fluorescence signal is generated that is visible to the eye or quantifiable by instrument. Total end user cost of the test is estimated at less than \$10.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The creation of this cost-effective fluorescent sensor for pesticides will enable the detection and estimation of the concentration of pesticides in water or soil samples. It will lead to a quicker and more effective evaluation of the presence of these pesticides along their chain of use in an agricultural environment, from the field to the worker and, in the future, to the consumer.

**TITLE OF RESEARCH:** FIELD-PORTABLE NITRATE/NITRITE SENSOR

**COMPANY:** REYTECH CORPORATION  
742 SE GLENWOOD DR.  
BEND, OR 97702

**PRINCIPAL INVESTIGATOR:** MR. THOMAS A. REYNOLDS

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$69,991/6 MONTHS

Nitrate contamination of drinking water is a major worldwide health threat and is responsible for many human and livestock illness. Excessive nitrates/nitrites in drinking water and the associated human health problems has prompted the EPA to set the maximum nitrate level in drinking water at 10mg/L (10 ppm) [1 mg/L for nitrites]. Unfortunately, no simple, cost-effective method exists for detecting nitrate levels in water-nor for routinely monitoring the performance of treatment systems designed to remove nitrates. The state-of-art method continues to be conventional off-site laboratory analysis. In Phase I ReyTech will investigate the feasibility of developing a cost-effective, user-friendly method of quantifying nitrate/nitrite levels in the field-in real time. Preliminary data obtained at ReyTech indicates the potential to successfully produce a self-contained system for rapid nitrate quantification down to sub-mg/L levels using a hand-held device that can be operated with minimal training. The Phase I plan is focused upon proving the feasibility of 1) designing the needed series of components for collection, processing, and reading/displaying/storing the test results; 2) fabricating and demonstrating performance of a bench-scale device; 3) identifying and minimizing potential interferences commonly found in water samples; and 4) integrating those components into a hand-held package.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The ultimate goal is to develop/commercialize an easy-to-use high performance device for nitrate/nitrite detection in the field. Phase I success would lead to a Phase II project designed to produce prototype units and to demonstrate their performance in actual field applications. Phase III commercialization would be carried out via private-sector partners. Success in this effort would increase the safety of drinking water worldwide-especially in agriculture areas - and would add substantial value to the results of a tandem project that the USDA is funding (as a Phase II SBIR) under which the company is developing a novel nitrate/nitrite - removal system.



**TITLE OF RESEARCH:** PRODUCTION OF PELLETTED FUNGAL INOCULA FOR USE IN FUNGAL-BASED REMEDIATION OF CONTAMINATED SOIL

**COMPANY:** EARTHFAX DEVELOPMENT CORPORATION  
1770 N. RESEARCH PARKWAY  
N. LOGAN, UT 84341

**PRINCIPAL INVESTIGATOR:** DR. RICHARD T. LAMAR

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$79,960/6 MONTHS

Fungal inocula are an important component of a soil bioaugmentation technology that relies on the pollutant-degrading abilities of white-rot wood decay (Bioremediation) fungi. Current inoculum production techniques are expensive and cumbersome. Preliminary work on a less expensive, technically superior inoculum formulation based on a pelleted lignocellulosic-based substrate covered with an active mycelial coat of a selected Bioremediation fungus, indicates that pelleted inocula are effective at supporting fungal colonization and pollutant degradation in soil and that they are potentially much less costly to produce than currently inoculum formulations. Equipment and supplies for three key steps in the pelleted inoculum production process require identification before a realistic economic analysis can be conducted. These steps include: pelleted substrate sterilization, fungal biomass fragmentation to produce hyphal fragments for pellet coating, and appropriate packaging to optimize uniform hyphal coat development on the pellets. The objective of the proposed work is to demonstrate the technical and economic feasibility of producing pelleted fungal inoculum, at the pilot scale.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

As a result of the proposed work we expect to identify an economic method for sterilizing the pelleted lignocellulosic substrates and a method for fragmenting fungal biomass, produced in liquid culture, to produce hyphal fragments which will be applied in an alginate slurry to the surface of the pellets to allow development of a hyphal coat over the pellet surface. In addition, packaging that is robust enough to withstand handling and which is designed to allow uniform hyphal coat development during the grow-out phase will be identified. As a result, fungal-based remediation, an environmentally harmonious soil remediation alternative, will be technically improved and applied more inexpensively.

**TITLE OF RESEARCH:** PORTABLE SENSOR FOR THE DETECTION OF NITRATES AND NITRITES IN GROUNDWATER

**COMPANY:** ELTRON RESEARCH INC.  
4600 NAUTILUS COURT SOUTH  
BOULDER, CO 80301-3241

**PRINCIPAL INVESTIGATOR:** DR. VERONICA M. CEPAK

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$79,997/6 MONTHS

This SBIR proposal describes a program to develop a small, portable, low-power amperometric nitrate and nitrite sensor for groundwater. A renewable, robust sensor integrated into a microfluidic system is proposed and will be designed to specifically detect nitrate and nitrite anions without significant dilution or reduction in the sensitivity of the detected species. The proposed microfluidic, electrochemical sensor will use sol-gel modified, screen-printed microelectrodes which will enhance the sensitivity and limit of detection of the device compared to electrodes of conventional size. The device will also use a simple pump and valve system for both electrolyte and sample introduction into the sensor compartment and proven electrochemical instrumentation for nitrate and nitrite detection. The proposed sensor will be applicable to real time, on-site monitoring of nitrate and nitrite concentrations in groundwater.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The quantitative determination of nitrate is of increasing interest for drinking water quality, wastewater treatment, the food industry and the control of remediation procedures. The control of water quality is also important to avoid contamination of food produced when water is used as a raw material. Furthermore, nitrate is also introduced into groundwater supplies (the sole source of drinking water for many rural communities) through inorganic fertilizers and animal manure from agricultural lands. The proposed sensor will be cost-effective and efficient and applicable to field portable monitoring for on-site, real-time detection.

**TITLE OF RESEARCH:** AERATED SUBMERGED BIO-FILM (ASBF) FOR  
WASTEWATER TREATMENT LAGOON ENHANCEMENT

**COMPANY:** TERO CONSULTING  
1155 W. STATE ST.  
LEHI, UT 84043

**PRINCIPAL INVESTIGATOR:** DR. KRAIG JOHNSON

**TOPIC AREA:** AIR, WATER AND SOILS

**GRANTED AMOUNT:** \$79,950/6 MONTHS

Wastewater treatment lagoons are the most widespread form of treatment in the United States for animal operations and rural domestic sewage. Treatment lagoons can be effective at removing BOD. They are not effective at reducing ammonia levels. Animal operations with recycled water from lagoons can experience high levels of ammonia in the water. This can result in severe odor problems and potentially toxic air quality. Removal of ammonia from wastewater requires two kinds of bacteria: nitrifiers, and denitrifiers. Nitrifiers are aerobic and thrive in an attached bio-film. Denitrifiers are anaerobic bacteria, and also thrive in bio-film. Traditional treatment lagoons provide no surface area for bio-film to adhere. Aerated Submerged Bio-Film (ASBF) consists of structures that stand submerged in a treatment lagoon. These structures provide surface area for a bio-film of the necessary bacteria. Compressed air released along the base of the surfaces allows air bubbles to rise, oxygenating the bio-film. The proposed technology is similar to traditional trickling filters, except that the oxygen is forced into the submerged bio-film, rather than wastewater pumped up to trickle down over a bio-film. This approach is much less expensive than trickling filters, and should significantly enhance the performance of existing lagoon systems.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The Aerated Submerged Bio-Film (ASBF) technology will permit rural communities and animal operators to retrofit existing lagoon systems at a fraction of the cost of alternative treatment technologies. The retrofitted lagoons should enhance the removal of BOD and greatly enhance ammonia removal. Existing undersized lagoons could then produce a water quality sufficient for discharge or reuse of the water in the animal operation. Improved performance of lagoons will eliminate a source of potential environmental contamination, as well as conserve fresh water supplies by allowing for reuse of animal operation wastewater.

**TITLE OF RESEARCH:** DEVELOPMENT OF AN INDUSTRIAL ON-LINE SENSOR

**COMPANY:** BRADLEY EXPERIMENTATION SOFTWARE  
TECHNOLOGIES, INC.  
P.O. BOX 289  
BOALSBURG, PA 16827

**PRINCIPAL INVESTIGATOR:** MR. MATTHEW J. BRADLEY

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$69,450/6 MONTHS

The need for economical on line sensors in the food industry is clear. Discussions with the food industry have led us to conclude that existing sensors do not meet their needs in terms of price and accuracy. Such a sensor must be non-contact and sufficiently rugged to withstand the industrial environment. Most important, it must be robust enough to accurately measure one component (i.e., salinity) despite changes in other components of conditions (i.e., pH or temperature). The proposed research is directed at developing an economical and accurate sensor using broadband microwave spectroscopy. Broadband microwave spectroscopy measures the electromagnetic energy frequency response to properties of the product being tested. Due to the nature of our industrial contacts, our research has focused on tomato-based products. Recent results have shown extraordinary promise as we have made a major breakthrough in the solution of the multivariate problem described earlier. Representatives of companies such as Campbell Soup and Heinz have shown great interest. Last year, we submitted a similar proposal. With the solution of the multivariate problem, we are now able to expand our research beyond the measurement of salinity. We can now demonstrate accurate measurements of several components and conditions simultaneously.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Our research will lead to a commercial on-line sensor with the following features: 1) Ability to measure multiple components simultaneously; 2) Rugged; 3) Economical (approximately \$15,000). Please note that our experiments have shown that our sensor is capable of measuring a variety of components, including salinity, pH, temperature, sugar, and vinegar. These sensors could be used throughout the food industry.

**TITLE OF RESEARCH:** QUANTITATIVE METHOD FOR CIGUATERA SCREENING

**COMPANY:** OCEANIT TEST SYSTEMS, INC.  
1001 BISHOP STREET, PACIFIC TOWER, SUITE 2970  
HONOLULU HI 96813

**PRINCIPAL INVESTIGATOR:** DR. JOANNE EBESU

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$79,772/6 MONTHS

As worldwide demand for fish products increases, ciguatera fish poisoning is becoming an expanding circumglobal problem. The need for seafood safety requires a rapid, quantitative method to detect ciguatera toxins in fish. Preliminary studies of a membrane immunobead assay (MIA) using fluorescent particles (FMIA) have shown it to be a rapid method to quantify ciguatoxin (CTX). Fluorescent spectral data, quantified with a spectrometer, demonstrated that the fluorescent immunobeads reacted with fish extracts containing CTX in a concentration-dependent manner. Scanning electron microscopy (SEM) photo analyses confirmed these results, supporting the feasibility of the FMIA method to detect CTX. In addition, two prototype fluorometers, one for laypersons and the other for laboratory or industrial use, have been designed and fabricated specifically to detect the fluorescent signal from the FMIA samples. Initial studies show that this fluorometer could distinguish between toxic and non-toxic FMIA samples. This project will focus on refining the FMIA procedure; quantifying samples prepared with pure CTXs, toxic fish extracts, and from reef fish associated with ciguatera; verifying toxicity of these samples with the MIA and neuroblastoma cell assay; improving the prototype fluorometers; and calibrating the fluorometers to accurately quantify FMIA samples.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The method to be developed in this proposal will provide a unique, rapid and effective quantifiable CTX detection method suitable for large-scale commercial use and smaller-scale recreational use. The CTX detection system would be accessible and easily operated by technical personnel as well as laymen. The markets for such a kit would be similar to those for the Cigua-Check® CTX detection kit: ciguatera-endemic area such as Hawaii, Guam, Florida, the Philippines, Japan, and the Caribbean; consumers of seafood harvested in these areas as well as countries importing seafood from these areas; commercial and recreational fishermen; diagnostic laboratories; and restaurateurs.

**TITLE OF RESEARCH:** FLUORESCENCE POLARIZATION ASSAY FOR THE DETERMINATION OF FUMONISINS

**COMPANY:** DIACHEMIX CORPORATION  
683 E. CENTER STREET, UNIT H  
GRAYSLAKE, IL 60030

**PRINCIPAL INVESTIGATOR:** DR. MOHAMMAD S. NASIR

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$70,000/6 MONTHS

Fumonisin (a mycotoxin that causes *leukoencephalomalacia* in horses, cancer in laboratory animals and esophageal cancer in humans) contamination of corn has guided the evolution of various methods for fumonisin measurement in grains. The existing fumonisin detection methods are labor intensive, time consuming and expensive and are not suitable for field-testing. We propose the development of a fluorescence polarization (FP) based sensitive, rapid and inexpensive quantitative assay for fumonisin detection that can be performed in the field. This test will be a major contribution to the grain community. Growers and processors will be able to conduct this test themselves in the fields or anywhere they need. Due to the use of organic solvents for fumonisin extraction, many technical and economical problems exist. We plan to extract fumonisin with water and analyze with FP. This technique is used for the homogeneous analysis of molecular interactions of small molecules with proteins, antigen-antibody interactions, hormone-receptor interactions, monitoring therapeutic drug levels and substances of abuse. In this proposal we plan to use FP to determine the fumonisin contamination in grains extracted with water.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Successful demonstration of a fluorescence polarization based fumonisin detection method in grains that is rapid, sensitive, inexpensive, and simpler to perform than the available assays and that is field portable, offers a practical way for grain producers and processors to check fumonisin levels before bringing their products to the market. This will save a lot of time, energy and resources. Similar tests can be developed for other mycotoxins that will help the growers in overall cost cutting.

**TITLE OF RESEARCH:** IMPROVED FRUIT JUICE CONCENTRATION PROCESS

**COMPANY:** COMPACT MEMBRANE SYSTEMS, INC.  
325 WATER STREET  
WILMINGTON, DE 19804

**PRINCIPAL INVESTIGATOR:** MR. JOHN BOWSER

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Concentration of fruit juices is a valuable unit operation. The current preferred method of juice concentration is triple effect evaporation. This technique cannot concentrate to high (75%) solids content without (1) developing a burnt taste to the sugar content and (2) driving off the low molecular weight hydrocarbons that provide most of the flavor and aroma difference between fresh and frozen concentrated juice. The need for a gentler process continues to be a major need associated with juice concentration. While membrane processes (reverse osmosis, ultrafiltration) offer excellent opportunity for avoiding exposure to high temperature, they have complications associated with irreversible interactions between membrane and juice components. Osmotic distillation (popular term for isothermal membrane distillation) is a process for removing water by water vapor transport across a non-wetted microporous membrane using concentrated salt solution to dewater the juice. While this process works well initially, surfactants and oils in juices tend to wet out the membrane, plus high viscosity concentrate builds up at surface, and performance is lost. In this osmotic distillation program we will develop high water flux hydrophobic and organophobic non-porous coating for microporous hydrophobic membranes that should have sufficient water vapor transport and should eliminate significant concern for membrane wetting out. Enhanced system design will minimize concentration polarization.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

High water flux non-porous hydrophobic/organophobic membranes should eliminate wetting out for osmotic distillation. The successful development of non-wetting osmotic distillation membranes should provide a valuable unique operation for developing high concentrations of various fruit juices with minimal loss in quality. Therefore almost all juices (orange, apple, grape-wine, tomato, etc) can be prepared cost-effectively as concentrate with no significant loss in performance.

**TITLE OF RESEARCH:** SUB-CRITICAL WATER EXTRACTION FOR THE ISOLATION OF POLYPHENOLICS FROM FRUITS

**COMPANY:** ARTEMIS INTERNATIONAL INC.  
9318 AIRPORT DRIVE  
FORT WAYNE, IN 46809

**PRINCIPAL INVESTIGATOR:** DR. JOLYNNE WIGHTMAN

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$61,850/6 MONTHS

During the typical juicing process, many polyphenolics of potential nutritive or functional value are left in the often underutilized pomace. Methods involving the use of acetone or ethanol are commonly used to further extract these compounds. However, these compounds are used as bioactive ingredients in dietary supplements and functional foods, or as natural colorants. Thus the health conscious target market has considerable objections to the use of solvents in production. Moreover, the complexity and cost-prohibitive nature of these processes cause many processors to simply discard the pomace and thus a potentially valuable source of phytochemical compounds (anthocyanins, flavones and catechins). Research has previously been conducted on the utilization of critical fluids as an environmentally friendly alternative to solvent extraction of valuable agricultural components. It is proposed that Sub-Critical Water Extraction can effectively extract polyphenolics from fruit pomaces. The alteration of the physical properties of water through increases in temperature and pressure allow it to function in a manner similar to less polar solvents such as acetone and alcohol. The evaluation of various conditions and extraction substrates can also demonstrate the feasibility of a Sub-Critical Water Extraction process to compete with solvent extraction in a cost-effective manner.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Successful evaluation of Sub-Critical Water Extraction will result in a cost-effective, environmentally sound, solvent-free process for the extraction of fruit bioactive compounds. Evaluated conditions will also allow for the more exact isolation of groups of compounds at a given set of parameters, which will be valuable in developing more clinically effective ingredients. The optimization trials of this process enables the manufacture of a range of ingredients in quantities sufficient for clinical and commercial evaluation. Finally, the solvent-free nature of this process allows it to be implemented at a wider variety of juice producers.



**TITLE OF RESEARCH:** AUTOMATED FOULING MITIGATION SYSTEM FOR DAIRY FILTRATION MEMBRANES

**COMPANY:** ELTRON RESEARCH INC.  
4600 NAUTILIS COURT SOUTH  
BOULDER, CO 80301-3241

**PRINCIPAL INVESTIGATOR:** DR. WAYNE E. BUSCHMANN

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$79,994/6 MONTHS

The proposed cleaning system will electrolytically generate the cleansing and disinfecting chemicals required for dairy processing filtration systems on-site consuming only water, electricity, and oxygen from air. The prototype 3-chamber electrolysis cell to be developed in Phase I will be used to determine the viability of applying this technology to the treatment of filtration systems. Alkaline hydrogen peroxide has increased cleansing and disinfecting power over pure solutions of each constituent individually. Hydrogen peroxide can be produced economically by this technology and is an environmentally gentle alternative disinfectant to chlorine and has much greater compatibility with filtration membranes. Processing milk and cheese whey by filtration has become a commercially valuable method for large-scale product separation and dairy waste treatment. Reverse osmosis and ultrafiltration are two of the most applied filtration methods currently used. Filter membranes must be regularly cleansed of milk fat, whey proteins and calcium deposits and be disinfected of harmful microorganisms. Cleaning is typically achieved by manual system flushing with alkaline and acid cleansers followed by disinfection with chlorine or hydrogen peroxide. The successful Phase I demonstration of the technology will be the basis for automated prototype system development in Phase II.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The technology will find application in industries requiring mitigation of biological fouling and disinfection or low concentrations of hydrogen peroxide. Those include aqueous recirculation systems such as water purification and food processing filtration units used in many industries, biofouling inhibition/removal in heat exchangers and cooling tower loops used extensively in the petrochemical and power generation industries, and sanitation for hospitals and the biotechnology industries. The technology will also have application in water purification, wastewater polishing, and ship ballast water treatment through hydrogen peroxide promoted advanced oxidation processes.

**TITLE OF RESEARCH:** AUTHENTICATION OF CANNED CRABMEAT BY SPECIES-DISCRIMINATING PCR-BASED DIAGNOSTIC

**COMPANY:** APL SCIENCES, INC.  
3610 NW 42ND TERRACE  
GAINESVILLE, FL 32606

**PRINCIPAL INVESTIGATOR:** MS. LEEANN APPLEWHITE

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$69,960/6 MONTHS

Species identification of blue crabmeat is necessary for the detection of inappropriately labeled products. Atlantic blue crab is the most valuable crab industry in the United States. Due to its high cost, popularity and demand Atlantic blue crab meat is susceptible to substitution using less valuable crab species. Authenticity of crab products marketed in the United States will ensure consumers are not misled about the source, safety and quality of crabmeat they purchase and consume. Traditionally, authentication of seafood products has been done by the generation of specific protein profiles. This technique is less reliable with heat-treated products such as pasteurized crabmeat. DNA-based identification techniques need to be investigated. Overall our proposed strategy requires isolation of DNA from crabmeat and its subsequent amplification utilizing the well-established technique of polymerase chain reaction or PCR that enables a sequence(s) of DNA to be targeted and amplified. DNA will be extracted as a template from various crabmeat sources. Gene-specific primers for species identification of pasteurized crabmeat will be developed and tested. Thermal pasteurization effects on the integrity of the extracted DNA template will be identified and the detection limits of mixed pasteurized crabmeat samples will be analyzed and established.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The commercial strategy of this proposal is to develop a diagnostic that distinguishes swimming crab species at the DNA level for verification of the authenticity of currently marketed canned Atlantic Blue Crabmeat. In providing a much needed evaluation tool for crab producers and regulators, this work has potential to serve as the platform technology for developing diagnostics for other niche markets in the food industry experiencing similar issues of fraudulent labeling of product.

**TITLE OF RESEARCH:** RAPID DETECTION OF *E. COLI* O157:H7, *SALMONELLA* SPP. AND *LISTERIA* SPP.

**COMPANY:** ADVANCED ANALYTICAL TECHNOLOGIES, INC.  
2901 SOUTH LOOP DRIVE  
AMES, IA 50010

**PRINCIPAL INVESTIGATOR:** DR. KRISTI R. HARKINS

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Rapid tests for microbial detection in food processing on the market today provide information on the presence or absence of specific pathogens after an enrichment process of 24 to 48 hours. Our method will utilize immunomagnetic separation after brief enrichment (<7 hours) using specific antibodies for each of these three pathogens to isolate and concentrate the bacteria from the food matrix (meat or surface debris). This clean sample will then be treated with a general DNA specific fluorochrome for cytometric detection. This method will be interfaced with a specialized flow cytometer (RBD2000) designed to provide accurate and low level detection of these fluorescent signals. Verification of the presence of each pathogen will be confirmed based upon comparison of cytometric detection with traditional plating techniques. The integration of capture, labeling and counting methodology will provide a fast and accurate presence/absence detection test for *Listeria* and *Salmonella* in poultry wash and *Listeria*, *Salmonella* and *E. coli* O157:H7 in carcass and plant surface samples.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The annual U.S. market for testing of specific pathogenic organisms was estimated to encompass 15 million tests during 2000. In comparison to other rapid technologies (PCR and antibody-based assays) on the market requiring long enrichment (24-48h), the development of these assays will provide faster turnaround times from sampling to answer for the detection of *Listeria*, *Salmonella* and *E. coli* O157:H7 pathogen presence or absence on food processing surfaces testing, in poultry wash and carcass swabs. These assays will have market potential to meat and food processing plants which average approximately 3,500 pathogen tests annually for each plant.

**TITLE OF RESEARCH:** A MICROFABRICATED ARRAY-BASED SENSOR FOR SEAFOOD FRESHNESS

**COMPANY:** LYNNTech, INC  
7610 EASTMARK DRIVE.  
COLLEGE STATION, TX 77840

**PRINCIPAL INVESTIGATOR:** DR. ANUNCIA GONZALEZ-MARTIN

**TOPIC AREA:** FOOD SCIENCE AND NUTRITION

**GRANTED AMOUNT:** \$80,000/6 MONTHS

The food industry, especially the meat and fish industry, is very concerned about the freshness of their products. Quality control at every step in the processing/distribution chain is essential to guarantee a tasty, wholesome, and most of all, safe food supply to the public. In general, available technologies for the determination of seafood freshness are time consuming and expensive, require complicated equipment and destructive sampling, and are difficult to perform outside the laboratory. Lynntech's array-based chemical sensor, i.e., "electronic nose", offers a low-cost solution to monitor food spoilage. The array-based sensor uses conductive polymer elements, which can be tailored to specific groups of target compounds, e.g., volatile bacterial metabolites given off by food during the spoilage process. The array produces an electronic signal pattern, or "fingerprint". The sensor will incorporate integrated circuits to control sampling and signal detection and analysis, including pattern recognition. Lynntech proposes to develop a user-friendly versatile system that is quick to respond, requires no consumables, and is portable. During the Phase I project, the feasibility of the sensor design at the bench scale will be demonstrated. During the Phase II project, a prototype sensor system will be developed and field-tested.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Other than in the food industry, Lynntech's "electronic nose" has a wide range of applications. In the environmental industry it can gauge the effectiveness of environmental remediation efforts and to detect the presence of toxic chemicals in environmental systems. In the perfume and drink industry, this sensor is particularly useful in analyzing complex vapor mixtures such as perfumes, beers, flavors, spoilage compounds, mixtures of solvents, etc. The agronomic industry can use the device for sensing pesticides in water and in fresh produce. In the medical industry the sensor can diagnose breath for disease screening and monitoring.

**TITLE OF RESEARCH:** DISEASE CONTROL FOR EMERGING VANILLA INDUSTRY

**COMPANY:** HAWAIIAN VANILLA COMPANY, INC.  
43-2007 PAAUILO MAUKA ROAD, PO BOX 383  
PAAUILO, HI 96776

**PRINCIPAL INVESTIGATOR:** MR. JAMES H. REDDEKOPP, JR.

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$79,750/6 MONTHS

A significant attempt is being made to establish a new vanilla industry in Hawaii. This industry will generate a new product for Hawaii and also employ displaced sugarcane employees. At present, several potential plant pathogens have been found at the new vanilla nursery. These fungi and bacteria need to be tested immediately as pathogenic species are major threats to vanilla vines. Disease-free plants need to be grown to test these fungi and bacteria. But more importantly, disease-free plants are needed to build a solid foundation for this new industry. New growers are already very interested in beginning their nurseries, but clean plants are an absolute requirement. In Phase I, the production of disease-free plants will be started and potential pathogens will be tested. In Phase II, a large stock of disease-free plants will be grown to supply new growers and to replace the present stock of contaminated plants at our nursery. Strong marketing arrangements are already in place and the demand for vanilla beans is very high.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The disease-free plants needed for the vanilla industry will be a major goal of this project. Using these plants, our nursery, as well as new growers, can expect many years of vanilla bean production. Without it, the crop will need to be replanted every 4 or 5 years and the financial burden of this process will impact the success of the business. Value added businesses such as coffee and ice cream companies are already purchasing every bean being produced. Demand is very strong for Hawaii grown vanilla beans.

**TITLE OF RESEARCH:** INTERNET-BASED TRAINING FOR UNLICENCED  
HEALTHCARE PERSONNEL IN RURAL COMMUNITIES

**COMPANY:** SOUTH DAKOTA HEALTH TECHNOLOGY INNOVATIONS  
1400 WEST 22ND STREET  
SIOUX FALLS, SD 57101

**PRINCIPAL INVESTIGATOR:** MS. MARY DERBY

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$79,974/6 MONTHS

Due to healthcare reforms, nursing shortages and other factors, hospitals, nursing homes and other health care facilities are using more unlicensed assistive personnel to provide direct and indirect patient care. These activities range from very basic activities such as transporting supplies to very sophisticated activities such as prepping patients. With proper training, unlicensed assistive personnel can be very competent caregivers. Healthcare facilities in rural areas have a particularly difficult time recruiting healthcare professionals and rely heavily on unlicensed assistive personnel. In rural areas the unlicensed assistive personnel do not have access to special training programs delivered by education department personnel in large urban medical centers. As a result nurses in rural healthcare facilities have to dedicate large amounts of their time to train new hires. This takes time away from patient care and is costly for the health care facility. The proposed research project would develop and test an Internet-based training program for unlicensed assistive personnel in rural areas. In Phase I, a prototype-training module for "Nursing Assistants" will be developed and tested with newly hired personnel at Sioux Valley Hospitals and Healthcare System and the Good Samaritan Society. Phase II would involve development and testing of an entire training program for a range of unlicensed assistive personnel that would then be marketed to healthcare facilities throughout the United States.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

There are thousands of hospitals, clinics, nursing homes, and other healthcare facilities that hire unlicensed assistive personnel. All of these new employees need basic training to effectively do their jobs. Industry partners in the project include the Good Samaritan Society, which manages nursing home and assisted living facilities throughout the United States and Sioux Valley Hospitals and Healthcare System with facilities in South Dakota Minnesota, Iowa and Nebraska.

**TITLE OF RESEARCH:** INCREASING RURAL IMPACT AND SUSTAINABILITY OF FARMSTEAD SOAP PRODUCTION

**COMPANY:** SCOTCH HILL FARM  
910 SCOTCH HILL ROAD  
BRODHEAD, WI 53520

**PRINCIPAL INVESTIGATOR:** MR. ANTON 'TONY' ENDS

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$65,596/6 MONTHS

Farmstead soap adds value to goat milk, greatly exceeding gross returns on raw milk sold to creameries (\$21/100 weight) and specialty farmstead cheeses (\$160/hundred weight equivalent). More than 60 3.5-ounce bars of soap, however, can be made from one gallon of milk. At \$3 per bar of soap, 100 weight of milk generates more than \$2,250 in gross income. Technical difficulties arise for traditional farm families who want to capture these value-added dollars by making and selling soap in quantity. Soap from 10 milking animals over 100 days' lactation exceeds 60,000 bars. The Phase I project will research and test feasibility of producing and selling high volumes of soap on a farm, profitably and sustainably. Working with a small-scale farmstead operation, Scotch Hill Farm In Brodhead, Wisconsin, the project will: 1) research and test sales volumes possible from expanding existing and additional markets; 2) test levels of soap productions possible and identify all costs and investments necessary; and 3) set up a model for duplication in a Phase II proposal with other producers in a guild and cooperative statewide.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Research will target one farmstead's production of 20,000 bars of soap per year. A Phase II effort will engage other goat milk Wisconsin Dairy Goat Association members to increase independent production, organize cooperative marketing and create a farmstead soap-making guild. It will target startup of at least 17 new enterprises near cities throughout Wisconsin. It will seek to strengthen independent farm producers' abilities to tap local markets in greater volume and achieve greater sustainability, while jointly pursuing institutional markets for soap (such as prisons and universities)

**TITLE OF RESEARCH:** APPLYING FRENCH *LABEL ROUGE* POULTRY SYSTEM TO THE US "PASTURED POULTRY" MOVEMENT

**COMPANY:** NEW HORIZON TECHNOLOGIES, INC.  
PO BOX 500, 3040 CONTINENTAL DRIVE  
BUTTE, MT 59702

**PRINCIPAL INVESTIGATOR:** MS. HOLLY BORN

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$79,720/6 MONTHS

"Pastured Poultry" is a grassroots movement that focuses on farm-scale production and direct-marketing to consumers. It provides supplemental income in rural areas but is limited by the number of birds a producer can realistically produce and market from the farm. Pastured poultry producers report good demand, but market penetration is not deep, since most consumers do not have direct contact with farmers. Producers typically use genetics designed for confinement systems. An industry is emerging from the grassroots movement but it remains uncoordinated. In France, free-range poultry produced under the *Label Rouge* national certification system command 30% of the market at high premium prices. Specialty pastured genetics are used. *Label Rouge* started as a grassroots movement 40 years ago. We propose to examine the feasibility of applying *Label Rouge* features to the grassroots movement and emerging industry in the U.S. Integrated production, processing, and marketing trials will be conducted on-farm to compare specialty genetics to standard genetics. Sensory analysis will be performed on the meat. We will carry out a farmer-led analysis of the feasibility of developing coordinated supply chains based on the French structure, and work with private certifying agencies to analyze the establishment of a quality label certification system.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The results of our Phase I investigation will provide an understanding of the potential that the French *Label Rouge* system holds for U.S. poultry farmers and factors affecting the adoption of specialty genetics, coordinated supply networks, and a national certification program. We believe the potential is substantial since the natural and organic food sectors are rapidly growing. According to the Hartman Reports, 52% of Americans want to buy "green". The goal of the project is to improve economic sustainability for small farms and rural communities.



**TITLE OF RESEARCH:** PHYTOREMEDIATION USING UNDEREMPLOYED AGRICULTURAL ASSETS

**COMPANY:** EDENSPACE SYSTEMS CORPORATION  
15100 ENTERPRISE COURT, SUITE 100  
CHANTILLY, VA 20151-1217

**PRINCIPAL INVESTIGATOR:** DR. MICHAEL J. BLAYLOCK

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Acknowledging the problems of drought and low farm prices, over the last three years the United States Congress has appropriated more than \$20 billion in emergency farm aid to boost farm incomes, encourage conservation, and buy crop and livestock insurance. At the same time, millions of acres of the country are contaminated with lead, other metals, and organic pollutants that are expensive to remove using traditional techniques such as excavation and landfill. Edenspace Systems Corporation seeks to conduct a market feasibility study on whether underemployed farm labor and equipment can conduct large-scale environmental cleanup by using living plants to degrade or extract contaminants in a process called phytoremediation. The study will (i) categorize contaminated sites suitable for phytoremediation, (ii) identify agricultural expertise and equipment useful for phytoremediation, (iii) assess the likely costs and benefits of the approach, (iv) describe regulatory requirements and issues, and (v) explore the acceptability of the concept to environmental stakeholders and farming groups.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

By bringing modern low-cost agricultural techniques to bear on major environmental problems, it may be possible to increase farm employment and revenue generating opportunities, particularly in rural areas, while at the same time improving environmental quality for Americans nationwide. The ability of farmers to improve the environmental quality of nearby land, using the same technology base they have developed for agriculture, should open a host of varied, widely distributed commercial opportunities

**TITLE OF RESEARCH:** QUALITY AND ITS ECONOMIC IMPACT ON RURAL SMALL BUSINESS IN MAINE

**COMPANY:** CENTRAL MAINE SOLUTIONS  
39 MAIN STREET  
SUMNER, ME 04292

**PRINCIPAL INVESTIGATOR:** MS. JENNIFER KIRLEY

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$76,898/6 MONTHS

Currently, small businesses face many challenges to success and growth. Rural regions particularly suffer from the lack of convenient, effective and affordable resources, inhibiting growth in the dominant service and other non-manufacturing sectors. These regions, upon suffering the higher-paying job losses from manufacturing shrinkage, struggle to maintain their vitality and promote economic recovery. Raising productivity, efficiency and profitability in the non-manufacturing small businesses sectors should also encourage employee development and education, further increasing their value to the economy and future generations. "High Performance Work Organizations" (HPWO) have been studied and discussed for many years, but for various reasons the small, non-manufacturing businesses are not receiving the same professional services as their larger, more resourceful competitors have enjoyed. CMS proposes development of Extension Partnerships that resemble their manufacturing counterparts, bringing practical application in line with current available information sources. CMS will research and test the ability to measurably improve regional economic conditions through the successful infusion of "best practices" that are currently employed by large, established and resourceful companies.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Organizations that successfully deploy these practices have, in certain studies, recorded returns four times greater than those of their counterparts. We expect similarly measurable gains in profitability when comparing HPWO against unimproved small businesses among the direct competition, thereby encouraging national implementation of this model. We will use economic formulae to project the expected economic benefits of reduced cost, professional consultation services to assist small businesses in training for, applying, and evaluating the HPWO practices within their businesses.

**TITLE OF RESEARCH:** SERVER-BASED COMPUTER APPLICATION TO IMPROVE AND STRENGTHEN THE COMMUNICATION AND EXPOSURE OF RURAL EDUCATIONAL FACILITIES

**COMPANY:** WEB-GALLERIES, INC.  
P.O. BOX 45476  
RIORANCHO, NM 87174

**PRINCIPAL INVESTIGATOR:** MS. JENNIFER SMITH HARRIS

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$51,168/6 MONTHS

The proposed Web-based informational database for rural educational facilities will enhance economic opportunity and quality of life for the educational facility and for the community. The primary object of the proposed Web-based informational database is to improve and strengthen the communication and exposure of rural educational facilities. We intend to develop the most efficient means of conveying information within the school and to the general public at the greatest ease to both the viewer and the information manager(s). It is our intention to create an online community environment where the information viewed may be managed and updated by anyone in the community with access. The online environment would be a server-based application as opposed to the client-based application. Web development companies do not need to be involved in the daily maintenance and operation of the proposed system. The communities may create and manage their own information, updating the online environment as desired with no programming or computer knowledge necessary.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The proposed informational online database would be designed specifically for rural education facilities to improve exposure of the facility to the general public, provide an online environment for the exchange of education/informational benefits for enrolled students and to provide the facility's employees and faculty with an online environment to exchange information with fellow colleagues and students. It will also offer email at a cost to the community as an Internet Service Provider. We believe that the daily sharing of community information in a rural education facility enhances the personal, social, economic and cultural values of a community. Phase III would involve contacting the over 6000 vocational schools and the 1,100 associate degree-granting institutions located in the U.S. We foresee that rural educational facilities will greatly benefit from the installation of this system.

**TITLE OF RESEARCH:** NATURALLY SELENIUM-RICH FOOD PRODUCTS

**COMPANY:** NIOBRARA NATURAL LLC  
BOX 48  
LUSK, WY 82225

**PRINCIPAL INVESTIGATOR:** DR. ROBERT C. ALBIN

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$80,000/18 MONTHS

The American High Plains and Eastern Wyoming, in particular, contain some of the most abundant sources of naturally-occurring selenium in the world. Certain edible plants when grown in these soils become rich in organic selenium themselves. During the last three years, two important findings have been established by Dr. Leif Thompson's investigation into selenium. First, a high-quality organic selenium-rich food product easily digested by humans has been created. Second, this product is safe for human consumption. In July of 2001, a patent was awarded for this naturally selenium-rich human food product developed for Niobrara Natural LLC by Dr. Thompson. There are two primary goals of this SBIR proposal, the first of which is to conduct a regional survey in order to locate and quantify cultivated crops containing high selenium levels. The second is to establish a field laboratory in Niobrara County Wyoming. The best strains of the various legumes and small grains collected from the survey will be cultivated in a common environment and then analyzed for selenium uptake and yield. This data will enable Niobrara Natural LLC to determine the best plant strains to use in production of high quality naturally selenium-rich food products. Niobrara Natural LLC was formed as a way to bring a lucrative economic opportunity to the agricultural producers in the High Plains region. Many rural communities, especially Niobrara County, are searching for ways to create value-added products so existing businesses can be retained and possibly expanded. Not only does this project offer this type of opportunity, it works within existing ecosystems which have been maintained and cared for by the people who know and understand them the best.

#### ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH

The anticipated results of Phase I research are essential for the future development of a variety of naturally selenium-rich food products. The patent search revealed there are no other naturally-grown products of this nature currently available. Preliminary market research has identified Canada, Japan and Europe as probable markets. Because the soils, particularly in Japan and Europe, do not contain significant amounts of selenium, food products grown there do not provide the minimum RDA needed for optimum health. Niobrara Natural LLC plans to construct a processing and packaging facility in Lusk, Wyoming for the successful commercialization of this product.

**TITLE OF RESEARCH:** COMMERCIAL INTRODUCTION OF BUILDING CONSTRUCTION PRODUCTS MAKING VALUE-ADDED USE OF ABUNDANT AGRICULTURAL RESIDUES

**COMPANY:** DPD, INC.  
2000 TURNER STREET  
LANSING, MI 48906

**PRINCIPAL INVESTIGATOR:** DR. HABIBUR CHOWDHURY

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$80,000/6 MONTHS

The ultimate goal of the proposed project is to commercialize a technology developed (and patented) through joint USDA/industry funding. This technology embodies formulations and processing conditions for value-added use of cereal straw, corn stalk and other fibrous agricultural residues in fiber cement boards for siding and backerboard applications in building construction. The subject technology replaces processed wood fibers with milled straw, corn stalk (and other residues) as reinforcement in cement boards. The availability of straw (more than 50 million tons/yr of straw can be harvested without lasting damage to soil), the high value of milled straw in our application, and the market potential of residue fiber cement boards promise to raise profitability of farming operations and provide new economic opportunities in rural areas. Residue fiber cement boards complement highly desirable attributes (strength, durability, dimensional stability, workability, fire resistance and aesthetics) with an attractive cost structure, which make them quite competitive in the multi-billion dollar siding and backerboard markets. Wood fiber cement boards have found use primarily in three major application areas: siding, roofing, and backerboard. The proposed project will: (1) develop a comprehensive business plan for the commercialization effort; (2) establish engineering and management resources for pilot-scale production and field demonstration of the technology; and (3) produce residue fiber cement board at pilot scale, and implement field evaluation and demonstration projects. The first task (business plan development) covers: (a) elaboration of the customer (building products distributors) and end-user (building contractors) needs and constraints; (b) analysis of major markets and competitors; (c) development of marketing/sales plan; (d) development of manufacturing/engineering plans; and (e) development of human resources plan. The second task involves build-up of the resources needed for pilot-scaled production and field evaluation/demonstration of the technology in Task 3.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Siding, roofing and tile backerboard markets in the United States consume 300 million m<sup>2</sup>/yr (3 billion ft<sup>2</sup>/yr) of board products; the share of fiber cement in these markets almost doubled from 1994 to 1999. The growing market share of fiber cement in building construction can be attributed to its desirable performance attributes (mainly durability characteristics), workability, ease of maintenance, and competitive cost position. Our preliminary economic analysis suggests that building construction markets can consume 1 billion ft<sup>2</sup>/yr/yr of residue cement boards in the United States, yielding gross sales of \$600 million/yr and accounting for 2 million tons/yr consumption of straw.

**TITLE OF RESEARCH:** GREEN TECHNOLOGY ASSESSMENT FOR RURAL COMMUNITIES

**COMPANY:** YELLOW WOOD ASSOCIATES, INC.  
228 NORTH MAIN STREET  
ST. ALBANS, VT 05478

**PRINCIPAL INVESTIGATOR:** MS. SHANNA RATNER

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$79,501/18 MONTHS

Rural communities must invest a range of infrastructure to support public services. Decision-making regarding municipal investments is often made by part-time, volunteer community leaders who lack access to up-to-date information regarding alternative technologies and approaches. Federal programs promoting alternative technologies are often focused on urban areas, with limited resources to address rural differences in scale, capacity, and financial resources. The fragmentation of Federal (and State) programs makes it difficult for rural communities to get a systemic overview of their infrastructure choices. The objective of this project is to create an assessment system that compares the performance, cost, and capacity of existing and proposal rural community municipal infrastructure with the performance, cost, and capacity of alternative technologies and approaches in a systems framework. YWA will use its experience with rural communities and economic development to engage a round table of technology experts in assessing existing and alternative infrastructure in the Town of Richmond, Vermont. The results of this applied research will enable us to document potential cost savings, cost avoidance, and employment creation implications as a basis for Phase II commercializations.

#### ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH

Our systemic assessment process will help communities in formulating cost-effective plans for phased implementation of appropriate alternatives. Rural communities will benefit through cost savings, cost avoidance, and potential creation of new employment opportunities related to the installation and maintenance of alternative technologies and approaches. Assuming tangible benefits, we believe the potential for commercial application with communities is positive. Alternative technology service providers benefit from increased access to rural communities. Service provider support for this project leads us to believe they may also support commercial application if Phase I is successful.

**TITLE OF RESEARCH:** A VALUE ADDED DAIRY PRODUCT CAN REVITALIZE FARMS AN RURAL COMMUNITIES

**COMPANY:** TABLE ROCK FARM, INC.  
5554 DE GOLYER ROAD  
CASTILE, NY 14427

**PRINCIPAL INVESTIGATOR:** MR. WILLARD DE GOLYER

**TOPIC AREA:** RURAL AND COMMUNITY DEVELOPMENT

**GRANTED AMOUNT:** \$37,210/6 MONTHS

Milk income has fluctuated erratically in recent years, and the effect is felt by farmers and by agriculturally reliant communities. To combat price uncertainty, we propose the creation of a conjugated linoleic acid (CLA) enhanced dairy product. Lab animal tests reveal that CLA is a potent anti-carcinogen. Dairy products are the major CLA source for humans, but a typical diet does not supply sufficient CLA to produce substantial health benefits. Small scale bovine studies reveal CLA levels in milk fat can be increased five-fold. This enhanced milk could be used to manufacture dairy products that meet hypothesized CLA effectiveness levels. Heightened consumer interest in nutraceuticals makes this an ideal time to produce a naturally enhanced version of "natures most perfect food", and thereby bolster faltering rural economies through stabilized farmer income, new industry, tax revenue and job creation. In this study, lactating, silage-fed Holstein cows in a commercial, confinement-housed herd will be fed an unsaturated fat supplement of plant oil, fish oil and Vitamin E to increase CLA production while maintaining milk fat yield. Milk will be tested weekly for CLA content and component production. Concurrently, a feasibility study will investigate risks and rewards associated with producing a CLA-enhanced product.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Data on supplementation rates and costs, changes in milk components, and CLA yield will combine to render a reproducible CLA enhancement formula. This information, matched with feasibility study results, will encourage farmer participation in a Phase Two prototype where multiple dairy producers in an economically depressed rural area implement study findings and produce enough CLA enhanced milk to attract a niche processing plant. The result? Improved income for self-sustaining farms, increased tax revenue and jobs for surrounding communities, better consumer health and an enhanced regional economic situation.

**TITLE OF RESEARCH:** FISH BEHAVIOR CONTROLLED FEED DELIVERY SYSTEM  
USING ACOUSTIC TECHNIQUES

**COMPANY:** PANTA REI, INC.  
PO BOX 391  
HAWTHORNE, CA 90251-0391

**PRINCIPAL INVESTIGATOR:** DR. ALI R. KOLAINI

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$79,789/6 MONTHS

Fish feed is one of the major costs in intensive aquaculture. Feed costs typically range from 30-60% of variable operating costs. Development of an efficient feeding system is needed to maximize growth rates of the fish while eliminating any overfeeding in doing so. Overfeeding has the double negative aspect of increased production costs and increasing the pollutant load from the system. Rapid advances in electronic control technology has led to the introduction of numerous types of automated systems for delivering feed to fish. Some of the recently developed systems rely on the usage of ultrasound, infrared, and visual feed detection that have shown positive results in commercial net pen applications. The proposed research is a focused effort to offer a robust passive acoustic system to monitor fish behavior at the initiation of a feeding event as the feedback mechanism to control feeding dosage. The advantage being immediate feedback to the feed control system so that the feed addition is immediately adjusted to suit the needs of the fish. Aggressive fish movement at the beginning of a feeding event results in air bubbles being produced that emit sounds. An automated hydrophone acoustic system can detect the radiated sound, thus providing a real-time instantaneous feedback monitoring of the fish's feeding behavior. Much as hand feeding relies on the human eye to gauge fish behavior and when to quit hand applying feed pellets to the pond/tank, the bubbles being generated by fish feeding behavior when the fish are aggressively feeding (the desired behavior) will also provide immediate feedback to an automated feed delivery mechanism. Field observations have confirmed the small variation needed to create aggressive feeding behavior and passive feeding behavior (assuming adequate water quality to promote feeding activity in the first place). In addition to the passive acoustic system, an active system that relies on the Doppler shift will be used to monitor the fish aggressive behavior when the sinking pellets are used in net pens.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Phase I will conduct laboratory tests that validates and provides proof of the concepts, resulting in a laboratory prototype. Phase II will be directed at developing a commercial prototype and will be conducted in conjunction with multiple commercial cooperators with multiple species, e.g. striped bass, salmon, tilapia, flounder, and perch. A PC based system for monitoring and controlling the fish feed delivery systems, which is integrated into a system controlling other parameters for managing the pond/tank will result. The availability of several competing products is a strong indication of the need for such a device. The proposed system is being based upon a robust technology that has been well developed in other applications. To some degree and also supported by our initial experiments, it should afford near term commercial application.



**TITLE OF RESEARCH:** DEVELOPMENT OF AN ULTRASOUND-MEDIATED DELIVERY SYSTEM FOR THE MASS IMMUNIZATION OF FISH

**COMPANY:** CLEAR SPRINGS FOODS, INC.  
P.O. BOX 712  
BUHL, ID 83316

**PRINCIPAL INVESTIGATOR:** DR. SCOTT E. LAPATRA

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$79,953/6 MONTHS

Losses due to disease in world aquaculture are estimated to be in the billions of dollars annually. Vaccination is effective in preventing disease for many fish pathogens, however, lack of cost-effective methods for delivering vaccines prevents vaccination from becoming more prevalent in aquaculture. We have shown how ultrasound can enhance the uptake of both dissolved compounds and particles from the aquatic medium into fish, non-invasively. Many vaccines that are efficacious by injection do not provide protection when delivered by immersion, however, an ultrasound mediated delivery system could eliminate the need for injection. DNA vaccines have been shown to be very effective in salmon and trout and are a promising alternative to traditional antigen-based vaccines but require intramuscular injection. What we are proposing is to develop an ultrasound-mediated delivery protocol that would enable the mass administration of a vaccine making the process considerably cost-effective, as well as less stressful to the fish. The model for development of this system would be a DNA vaccine attached to biopolymer nanoparticles which we have shown can be used to successfully deliver DNA, including DNA vaccines. The efficacy of the delivery system for rainbow trout will be evaluated by determining gene expression, elicitation of a humoral immune response, and protection from lethal virus challenge.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

An ultrasound mediated delivery protocol for vaccines will enable fish in commercial aquaculture to be vaccinated en-masse, in a cost-effective manner, with a minimum amount of stress to the fish. Once developed, the protocol will be immediately available for existing DNA vaccines, and will stimulate future development of other vaccines against existing and emerging pathogens. An effective vaccination protocol will directly contribute to improving production efficiency and reducing environmental impacts of aquaculture, thus making it more sustainable. The end result will be increased domestic production, which will both help generate employment and decrease the trade deficit between imported and exported seafood in the United States.

**TITLE OF RESEARCH:** USE OF HIGH PROTEIN FEEDS TO IMPROVE FEED EFFICIENCY AND WATER QUALITY IN CHANNEL CATFISH CULTURE

**COMPANY:** DELTA WESTERN RESEARCH CENTER  
P.O. BOX 878  
INDIANOLA, MS 38751

**PRINCIPAL INVESTIGATOR:** DR. EDWIN H. ROBINSON

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$64,800/18 MONTHS

The issue of organic and inorganic wastes from aquaculture production have received considerable attention in recent years due to the negative effects these wastes may have on the culture systems and on receiving waters. The primary origin of these waste comes from the feed. Wastes from unassimilated feed and the fish's metabolic process negatively affect water quality and fish growth. One way to reduce waste production and to improve water quality without affecting fish growth is to feed catfish high protein feeds at a rate that is less than satiation but still meets daily protein and energy requirements. Such feeding strategy may minimize nutrient input, improve feed utilization, reduce waste, and thus improve water quality. Also using high protein diets and feeding less than satiation may improve processing yield and reduce body fattiness of catfish products. Four experimental feeds will be formulated to contain 28, 32, 36, and 40% protein. Each feed will be fed to catfish once daily to satiation or no more than 90-112 kg/ha (80-100 lb/ac) in 0.04-ha (0.1-ac) earthen ponds from May to October, 2002. Five ponds will be used in each diet x feeding rate combination (a total of 40 ponds). Production and processing characteristics, body composition, and water quality parameters will be determined. Economic evaluation of different treatments will be also conducted.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

If high protein feeds can be fed to catfish at a rate that is less than satiation but still meets daily protein and energy requirements of catfish without adverse effects on fish production, feeds may be utilized more efficiently and less solid waste may be generated. This should result in better water quality in terms of improved dissolved oxygen levels and less sediment accumulation in catfish ponds. The current low feed cost may make such feeding strategies economically possible. In addition, processing yield may be increased and body fattiness reduced using high protein feeds, which will benefit the catfish processing industry and consumers of catfish products.

**TITLE OF RESEARCH:** ESTIMATION OF FISH BIOMASS AND SIZE IN  
AQUACULTURE PENS USING DIGITAL ECHOSOUNDER

**COMPANY:** BIOSONICS, INC.  
4027 LEARY WAY NW  
SEATTLE, WA 98107

**PRINCIPAL INVESTIGATOR:** DR. JANUSZ BURCZYNSKI

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$79,835/6 MONTHS

Current methods for assessment of biomass and size of fish for aquaculture companies require excessive handling of the fish. This induces mortality, slows growth and causes illness. Results produced by these methods are inaccurate, labor intensive and increase production costs. Assessment of biomass and fish size in aquaculture is needed for a number of reasons, including: (a) determining feed rates according to the number and size of fish in each pen, (b) appraisal of growth rates and food conversion factors, (c) inventory of fish required by banks and insurance companies, (d) early detection of fish losses, and (e) determining proper dosages for the treatment of disease. Acoustic systems are used to estimate fish biomass and size in marine and freshwater environments. Attempts to apply acoustic technology to the monitoring of fish biomass and size in the aquaculture industry have failed to produce a cost-effective system for industrial application. We propose to demonstrate the feasibility of an innovative acoustic system based on digital sonar technology using split beam transducers with rotators. Our work plan focuses on modeling and experimental verification of acoustic techniques. Preliminary experiments using analog technology produced results indicating that the new generation digital sonar system is feasible.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

We anticipate developing a method for the assessment of biomass and fish size in sea pens. We expect to test the model using simulation techniques and a series of controlled experiments on live fish in sea pens using digital sonar technology. Results of these experiments will enable us to design and integrate an acoustic system for application in aquaculture. Phase II will focus on necessary modifications and the building of a prototype for industrial implementation. Potentially, this acoustic digital system could increase both the efficiency and profitability of salmon farms in the United States and worldwide.

**TITLE OF RESEARCH:** PLOIDY APPLICATION FOR ADDED VALUE AND STOCK PROTECTION OF DOMESTICATED PACIFIC WHITE SHRIMP

**COMPANY:** HIGH HEALTH AQUACULTURE (HHA)  
P.O. BOX 1095  
KURTISTOWN, HI 96760

**PRINCIPAL INVESTIGATOR:** DR. JAMES WYBAN

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$80,000/6 MONTHS

This SBIR Phase I research will establish reliable technology to produce tetraploid broodstock of Pacific white shrimp (*L. vannamei*) using a new, Automated Polyploid Induction System (APIS). We will determine optimal values for tetraploidy induction based on three parameters: time post-fertilization to start shock, shock intensity, and shock duration. These values will allow us to fully develop and apply APIS during Phase II. Tetraploid broodstock thus produced will be used to produce sterile triploid seedstock during Phase II, when their commercial performance will be assessed. Since triploid seedstock are sterile, this technology will protect our investments in stock improvements. Farmed shrimp production has stagnated since 1990 due primarily to viral diseases. Use of hatchery produced, disease-free and -resistant stocks will reduce reliance on wild-caught stocks, the primary source of shrimp diseases. However, genetic improvement of domesticated shrimp stocks requires substantial financial investments. Technology that protects these investments is essential for attracting capital. Once this technology is available, investments in shrimp genetics will follow. We will position our company for expansion by being at the forefront of polyploidy applications in shrimp culture, and by protecting our investments in our shrimp stocks.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Successful mass-production of fertile tetraploid shrimp broodstock, and sterile triploid shrimp seedstock will allow us to accelerate investments in developing genetically improved shrimp stocks. We will then sell only tetraploid/diploid pairs of SPR/SPF Pacific white shrimp broodstock to hatcheries worldwide. With these, our customers will produce only sterile triploid progeny for growout of food-grade shrimp, but will be unable to establish breeding populations from our improved shrimp stocks. In addition, triploidy may also confer improved stock performance traits including faster growth and/or increased disease resistance. These unique values will attract capital and allow us to greatly expand our company.

**TITLE OF RESEARCH:** DEVELOPMENT OF ANTIBODIES FOR THE DETECTION OF 2-METHYLISOBORNEOL (MIB) BY IMMUNOASSAY

**COMPANY:** ABRAXIS LLC  
2935 BYBERRY ROAD  
HATBORO, PA 19040

**PRINCIPAL INVESTIGATOR:** MR. FERNANDO M. RUBIO

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$79,919/6 MONTHS

The aquaculture industry considers off-flavor in catfish to be one of the biggest problems facing the industry and representing a significant cost to catfish farmers and processors due to the unmarketability of the fish that have acquired these distasteful compounds. To avoid marketing fish with off-flavor, fish are screened for flavor quality before harvesting. Current quantitative chemical analysis is inadequate for flavor quality control because of time constraints and the high cost involved. Another technique utilizing human flavor testers is sensory analysis, although rapid and relative inexpensive, human assessment is prone to errors due to sickness, fatigue and variability among testers. In this work we propose to develop and produce monoclonal and polyclonal antibodies which react with 2-methylisoborneol (MIB) with sufficient selectivity, affinity, and avidity to be utilized in a low cost and rapid commercial immunoassay system, which ultimately benefit farmers, processors and consumers by ensuring a high quality product. Production of these antibodies is described including the immunogens, injection schedule, screening process, hybridoma development, polyclonal and monoclonal selection criteria.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Development and production of antibodies raised against 2-methylisoborneol (Phase I) is intended to result in a low cost, on-site and rapid immunoassay system (Phase II). Abraxis LLC would commercialize this immunoassay for the detection and monitoring of “off-flavor” caused by 2-methylisoborneol in agricultural products, drinking water supply, as well as in wine, allowing more precise and corrective treatments.

**TITLE OF RESEARCH:** PROBIOTIC SYSTEM FOR BIVALVE SHELLFISH  
AQUACULTURE

**COMPANY:** AQUATECHNICS, INC.  
PO BOX 687  
CARLSBORG, WA 98324

**PRINCIPAL INVESTIGATOR:** DR. RALPH A. ELSTON

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$79,622/6 MONTHS

There has been increasing interest in the use of beneficial bacteria (probiotic bacteria) to exclude bacterial pathogens in the intensive aquaculture of bivalve mollusk seed, shrimp postlarvae, and larval fish. As our work and that of others have shown, marine bacterial strains with probiotic activity are not uncommon. However, a validated method for the biologically effective and cost effective method of producing, introducing and maintaining the probiotic bacteria in bivalve shellfish systems is required. The primary subject of this proposal is to test the addition of promising probiotic bacterial candidates (presently archived in the laboratory), grown as monocultures, to larval and juvenile oyster cultures and evaluate their ability to protect the shellfish from challenge by bacteria pathogens. Promising candidates will be characterized for optimal concentration and frequency of addition in order to establish a recoverable and biologically protective concentration of probiotic candidates. Phase I studies will be conducted in laboratory microcosm cultures followed by scale up to commercial size cultures in Phases II and III. There will be a limited evaluation of compatibility of probiotic bacteria with algal cultures and evaluation of any potential for resistance development of pathogens to probiotics.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

This project has the potential to reduce variation in bivalve shellfish seed production resulting in the production of a more healthy product within hatcheries and nurseries and after transfer to growing grounds. Greatly improved efficiency and predictability of shellfish seed production will result from application of a stably incorporated set of probiotic bacteria that will reduce or eliminate the serious effects of common bacterial diseases. Commercial application of this technology will be production and availability of probiotic bacteria that will be added to larval and juvenile shellfish tanks in bivalve hatcheries and nurseries under specific conditions.

**TITLE OF RESEARCH:** DEVELOPMENT OF ALL-FEMALE POPULATIONS OF STRIPED BASS

**COMPANY:** KENT SEATECH CORPORATION  
11125 FLINTKOTE AVENUE  
SAN DIEGO, CA 92121

**PRINCIPAL INVESTIGATOR:** MR. JAMES M. CARLBERG

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$79,937/6 MONTHS

Striped bass culture has become the fourth largest form of fish production in the U.S., trailing only catfish, trout, and salmon in terms of market value. Unfortunately, this promising new industry faces considerable market pressure from foreign competitors who often enjoy lower labor, water, and utility costs and fewer environmental regulations than encountered in the U.S. To compete effectively, U.S. producers must develop new technologies to lower production costs and assist them in dealing with inexpensive foreign imports. One promising concept involves the use of modern sex-reversal techniques to produce monosex populations. It has been shown that monosex populations of several cultured species, including trout and tilapia, grow more rapidly and efficiently compared to mixed sex populations. In preliminary studies, Kent SeaTech has found that female striped bass may grow up to 35% larger than their male siblings. If advanced culture technologies can be developed to take advantage of this growth difference under commercial production conditions, the U.S. striped bass culture industry would have a strong advantage over foreign producers. We propose to conduct research to develop methods of producing all-female populations of striped bass and to ascertain whether this concept would result in significant cost benefits to U.S. producers.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The development of techniques for producing all-female populations of striped bass would be extremely beneficial in the commercial culture of this species, both in intensive (tank and raceway) and extensive (pond) culture systems. Increased growth and food conversion efficiencies would provide increased production volumes and decreased production costs. Enhanced growth rates may be particularly advantageous in pond-based operations, which have a limited growing period due to seasonal water temperatures. The ability to attain more rapid growth during the warmer months could conceivably cut an entire year from the production cycle in extensive systems.

**TITLE OF RESEARCH:** MULTIELEMENT SELECTIVE EMITTER

**COMPANY:** SONSIGHT PROJECTS, INC.  
17609 CLINTON DRIVE  
ACCOKEEK, MD 20607

**PRINCIPAL INVESTIGATOR:** DR. DEVON R. MCINTOSH

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$80,000/6 MONTHS

The proposed research is directed at demonstrating the feasibility of a new type of grow lamp. Based on incandescent light generation, it potentially provides a much more sun-like spectral distribution than what is possible with HID or other lamps. The innovation is based on structuring a ceramic oxide to emit much more efficiently at shorter wavelengths than tungsten, thereby shifting its emission spectrum to closely resemble that of natural sunlight. Prior work at lower temperatures demonstrated the predicted shift in the spectrum, and the current proposal is directed at demonstrating a similar shift at the expected 2650 K operating temperatures. Although, for the same input power, the incandescent emitter is expected to generate less total PAR power than HID lamps, its spectral intensity distribution is strong in both the short and long wavelength absorption regions of chlorophyll *a* and *b* such that the resulting photosynthesis rate is 30% greater than that of MH grow lamps and 43% greater than that of HPS lamps. Compared with a standard incandescent bulb, the proposed emitter generates much less infrared radiation and is thermally insulated from its glass enclosure by a high vacuum, therefore it burns much cooler. Demonstrating the feasibility of a novel method of heating the emitter is also a goal of the proposed work. In addition to a more sun-like spectrum than other lamps, the proposed lighting will need no external ballast, making it simpler and significantly less expensive to manufacture.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The innovation will promote widespread use of hydroponics and aquaculture by allowing increased yield for less cost. As such it will help develop sustainable agricultural production systems and help create a safe, nutritious and affordable food supply. It will also help decrease the discharge of mercury and greenhouse gasses into the environment and decrease our consumption of oil. As such it protects natural resources and the environment and enhances global competitiveness.



**TITLE OF RESEARCH:** SPAWNING AND HATCHERY TECHNOLOGY TO IMPROVE  
HYBRID CATFISH FRY PRODUCTION

**COMPANY:** HARVEST SELECT FARMS  
P.O. BOX 560  
INVERNESS, MS 38753

**PRINCIPAL INVESTIGATOR:** MR. ROGER YANT

**TOPIC AREA:** AQUACULTURE

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Catfish production, 300 million kg annually, is 70% of all U.S. aquaculture production. In many impoverished areas of the South, this industry is critical for the economic viability of communities. Imports of fish products resulted in a \$10.7 billion trade deficit in 2000. Imported catfish now threaten profits of catfish farms. Impediments to sustainability and competitiveness such as, slow growth, inefficient feed conversion, mortality from disease and the associated use of chemicals, loss of fish from low oxygen, inefficient harvesting, inefficient use of land space and processing waste can be diminished by utilization of the channel X blue catfish hybrid. This hybrid exhibits increased growth (20-100%), feed conversion efficiency (10-20%), disease resistance and survival (10-50%), tolerance of low dissolved oxygen (50-100%), harvestability (100%), brook-and-line vulnerability (100%) and carcass yield (10%). This hybrid would revolutionize catfish production, but behavioral reproductive isolating mechanisms prevent consistent large-scale production of this hybrid despite large demand. Recent research indicates induced spawning with LHRH, brood stock nutrition and controlling fungus in the hatchery may be the keys to successful hand stripping for production of hybrid embryos. The efficiency of hybrid embryo production needs to increase to a competitive level by identifying the most economic technology to increase hatch of eggs. Objectives are to determine the seasonal variation of dosages of LHRH needed to efficiently induce females, determine proper nutritional preparation of brood stock and determine the best treatments to control fungus. Results from treatment variables will be compared economically to determine the direction of Phase II research to solve this problem.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The anticipated result is that hybrid embryo production will be increased to the extent that large scale commercial adoption of this hybrid will occur resulting in a revolutionary advance in sustainability and profitability in the catfish industry which is now almost entirely based on the culture of channel catfish. Even in a dynamic, commercial environment, the adoption of hybrids can have huge impacts, through cost efficiency, premium selling prices, i.e., enhancing sustainability and profitability and providing sustainable, economic community development. The adoption of the hybrid will not only benefit large farms, but also aid small farms with alternative enterprise income, reduce chemical use and be environmental friendly. Use of this reproductively limited hybrid could better protect natural genetic resources.

**TITLE OF RESEARCH:** EXTRACTIVE FERMENTATION FOR PRODUCTION OF LACTIC ACID FROM CORN STARCH BY FILAMENTOUS FUNGI IMMOBILIZED IN FIBROUS BED BIOREACTOR

**COMPANY:** ENVIRONMENTAL ENERGY, INC.  
P.O. BOX 15, 1253 N. WAGGONER ROAD  
BLACKLICK, OH 43004

**PRINCIPAL INVESTIGATOR:** MR. DAVID RAMEY

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$80,000/6 MONTHS

Lactic acid fermentations have been extensively studied in the past decade. Almost all previous studies and current commercial processes use glucose or lactose and very little has been done with starch as the substrate for fermentation. There is a cost advantage in using starch, instead of glucose, for fermentation. The goal of this project is to develop a novel fungal extractive fermentation process to economically produce L(+)-lactic acid from corn meal (starch) generated in a corn dry-milling process. Several new approaches to enhance lactic acid yield and productivity from direct fungal fermentation of starch will be studied in this project. First, immobilization of the mycelial cells in a porous fibrous matrix to control cell morphology and to enhance mass transfer, viable cell density, and reaction rate will be studied. Using immobilized cells with reduced or minimal growth activity should also enhance the lactic acid yield as less carbon source will be used for cell biomass and ATP formation. Second, extractive fermentation to separate lactic acid *in situ* to reduce product inhibition and to further enhance the fermentation rate will be studied. Lactic acid in the fermentation broth will be separated by solvent extraction in hollow-fiber membrane extractors. It is believed that by selectively removing lactic acid from the fermentation broth continuously, the fermentation pathway can be shifted to produce more lactic acid and less other byproducts.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The interest in producing lactic acid from biomass by fermentation is high because of the large potential market for biodegradable poly-lactic acid (PLA) and lactate esters as green solvent. The new fermentation technology developed in this project will provide an energy and cost effective way to make lactic acid and its derivatives from low-cost agricultural commodities and byproducts. A commercial plant to produce lactic acid from corn meals (starch) generated as a byproduct in a corn dry milling plant producing corn protein isolate will be built based on the technology developed in this project.

**TITLE OF RESEARCH:** FINE CHEMICALS FROM AGRICULTURAL RESIDUES

**COMPANY:** PLANT POLYPHENOLS, LLC  
P.O. BOX 12522  
ALEXANDRIA, LA 71315-2522

**PRINCIPAL INVESTIGATOR:** MR. RICHARD W. HEMINGWAY

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$58,554/6 MONTHS

Flavonoids and proanthocyanidins are potent anti-oxidants and have recently found considerable interest in their potential for reducing risks or treatments of heart disease, cancer, and microbial infections. To make further progress in understanding the biological significance of these compounds, it is necessary to provide biologists with gram to kilogram amounts of pure compounds at a reasonable price. It is also necessary to be able to assure the potential to produce tonnage quantities should drug discovery and development be successful. Because oligomeric proanthocyanidins are usually found in only low concentrations even in plant tissues containing high concentrations of tannins, production of these compounds in gram quantities by direct extraction is usually not feasible. Therefore, this research is directed to optimizing ways to use abundant agricultural waste products as a source of flavan-3-ol derivatives that can be used as intermediates in the "semi-syntheses" of a wide variety of plant proanthocyanidin derivatives. Successful development of processes to produce these flavan-3-ol derivatives will open the door to production of a wide variety of proanthocyanidin derivatives and allow us to optimize the biological properties of these compounds.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

It is anticipated that we will be able to use the tannins in agricultural waste products as a source of flavan-3-ol derivatives. Successful production of these compounds will provide intermediates useful in making a wide variety of bioactive proanthocyanidins in gram or even tonnage quantity and thereby overcome a major obstacle to drug discovery and development from plant polyphenols. Success in this work should stimulate all aspects of our business from consulting with other companies and universities to sales of fine chemicals.

**TITLE OF RESEARCH:** MODIFIED SOYBEAN HULLS FOR HEAVY METAL REMOVAL

**COMPANY:** PEAT TECHNOLOGIES CORPORATION  
105 4TH STREET, NW  
AITKIN, MN 56431

**PRINCIPAL INVESTIGATOR:** MR. TIM HAGEN

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$77,860/6 MONTHS

A major problem facing the metals products and machinery (MP&M) industry are the recently proposed effluent limits for heavy metals set by the US Environmental Protection Agency under Rule 66 FR 423. Current technology cannot consistently meet these effluent limits. This has forced the MP&M industry to search for new and innovative treatment technologies designed to polish their effluents to the new limits. Recently completed laboratory studies conducted by the USDA-ARS, Southern Regional Research Center (SRRC) New Orleans, Louisiana, have shown that soybean hulls modified with citric acid can effectively remove toxic and heavy metals from wastewater streams and may effectively meet these newly proposed limits. Indications are that this new product will have ion-exchange performance approaching conventional ion-exchange resins but at a significantly lower cost. However, the technology is only available at the laboratory-scale level. The proposed program, which will be carried out in close cooperation with the SRRC, is specifically directed at scaling-up their modified soybean hull manufacturing technology and designing a modular treatment system for implementation at several electroplating facilities in Phase II. This will demonstrate the use of the new technology under actual operating conditions, providing ultimate evaluations of system metal removal efficacy.

#### ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH

Successful completion of this program will offer a simple, cost effective, and practical approach for MP&M facilities to polish and treat their wastewaters to the proposed new effluent limits. This could save the MP&M industry millions of dollars per year and prevent many small operators from going out of business. In addition, the favorable aspect of successfully exploiting higher-valued uses for soybean hulls offers the agricultural community additional market outlets for essentially low-valued materials.

**TITLE OF RESEARCH:** PHASE CHANGE MATERIALS FROM FATS AND OILS

**COMPANY:** CHEM CHAR  
2005 WOODLEA DRIVE  
COLUMBIA, MO 65201

**PRINCIPAL INVESTIGATOR:** MR. WILLIAM R. SUTTERLIN

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$80,000/6 MONTHS

This project proposes to synthesize phase change materials (PCMs) from bio-based fats and oil and test these PCMs during a Phase I SBIR Program. PCMs are increasingly being used in residential and commercial building construction to reduce energy demands and costs for heating and cooling. Unfortunately, most PCMs are currently derived from petroleum products. The innovative bio-based PCMs to be developed during this SBIR Project represent an environmentally friendly and renewable alternative to conventional PCMs. During Phase I, the project will 1) demonstrate that PCMs with the proper melting point ranges can be produced from beef tallow and soybean oil feedstock, 2) characterize the performance of these products as PCMs, 3) identify viable additives and encapsulation methods to provide desired product life, and 4) identify robust and economically viable products for which processing details would be specified in Phase II investigation. The technology is protected by patent applications-on product synthesis and compositions. The project includes an impressive team including the University of Missouri Department of Chemical Engineering, which has conducted extensive research into bio-based fuels and products.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

A successful Phase I proposal will demonstrate that room temperature PCMs can be produced from fats and oils at high yields in a robust and relatively inexpensive process, providing the foundation for Phase II, in which a pilot facility will be built, made operational, and produce product. Bio-based PCMs could be produced for less than \$0.20 per pound, versus \$0.35 per pound for paraffins, currently the least expensive room-temperature PCMs. It is estimated that the market for bio-based PCMs could rise into the billions of dollars per year as the U.S., Canada, and Europe place increasing emphasis on energy efficiency efforts.

**TITLE OF RESEARCH:** PRODUCTION OF METHYL ETHYL KETONE BY A NEW METHOD FROM CORN FIBER

**COMPANY:** GENERAL RESOURCE TECHNOLOGY, INC.  
4200 NORTH, 300 WEST  
WEST LAFAYETTE, IN 47906

**PRINCIPAL INVESTIGATOR:** DR. GEORGE T. TSAO

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$80,000/6 MONTHS

This project deals with production of methyl ethyl ketone (MEK) from corn fiber. Corn fiber is consisted of mostly hemicellulose that can be hydrolyzed to produce a mixture of sugars. Extensive work has been done on fermentation by *Klebsiella oxytoca* that can metabolize all hemicellulose sugars and give a 50% weight yield of a compound called 2,3-butanediol (BDO). BDO has a boiling point of 180°C. To recover BDO from fermented broth involves energy intensive evaporation of a large amount of water and then vacuum distillation. BDO can be converted into MEK by dehydration. MEK with a boiling point of 79.6°C can be purified by simple distillation. Work has been done on dehydration of pure BDO to MEK with sulfuric acid as a catalyst. This project has its objective of testing the use of crude BDO in fermented broth, without first being purified, directly in dehydration. If successful, a 2-step process will be possible for conversion of corn fiber first to BDO by fermentation and then to MEK by acidic dehydration. Impurities in the fermented broth including residual sugars and proteins have been reported to interfere with the dehydration reaction. This Phase I project work is to eliminate such possible interferences by different methods including complete sugar metabolism, pretreatment of ion exchange resins and/or activated carbon, etc. Work will also be done using solid acids such as zeolite ZSM-5 to replace sulfuric acid in dehydration. The zeolite cage structures may reject large molecules such proteins from interfering. Use of solid acid also avoids otherwise a waste sulfuric acid stream. The activity half-life of zeolite in an aqueous reaction will be carefully determined.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

With the greatly expanded ethanol production, new uses are needed to dispose the excessive byproduct, corn fiber. MEK, at \$0.46 per pound, is a bulk chemical with an annual worldwide consumption of 1.2 million tons, growing at a rate of about 2% per year. Corn fiber is currently marketed as an ingredient in animal feed. Feed products are priced according to protein contents and corn fiber is disposed by this outlet but brings no financial benefits to the processor. With the cheap corn fiber and the high efficiency, MEK by the new method is competitive. Preliminary analysis shows a direct production cost of less than 20 cents per pound. Shell Chemical Company, the world's largest MEK producer by petrochemical synthesis, endorses a feasibility study of this new hybrid biological/chemical method of MEK production.

**TITLE OF RESEARCH:** A KENAF FIBER BASED END-GRAIN SANDWICH CORE MATERIAL FOR COMPOSITES

**COMPANY:** POLYMER BRIDGE SYSTEMS INC.  
1001 CHALKSTONE DRIVE  
MITCHELL, SD 57301

**PRINCIPAL INVESTIGATOR:** MR. DALE RYAN

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$79,600/6 MONTHS

The high cost of core material in the composites industry remains a significant barrier to expansion. Composite projects, designed to replace metal, concrete, or wood, especially large projects such as bridge decks, regularly fail when it comes to cost analysis. The composites industry, for fifty years, has relied upon end-grain balsa wood core, due to its strength and low weight, as the material of choice. Balsa average 9 lbs/cubic foot density whereas other woods are 30 lbs. cu. ft. and up. The kenaf inner fiber is 7-8 lbs/cubic foot and a fraction of the price of balsa. A Kenaf-based core provides "balsa-like" inner fibers, and when the sticks are pressed and bonded they become a very strong "end-grained" block. The resulting core appears to be stronger than balsa in compression and "core-shear" due to the smaller diameter sticks. Core shear is the all-important test when one evaluates the dynamic behavior of a composite sandwich cored structure, and load-carrying ability in compression determines the overall strength of the sandwich-cored part. The proposed project shall demonstrate the feasibility of this material as a composite sandwich core.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Successful test results would verify initial findings and lead to a full-scale demonstration of the new core. The core's retail cost would be several orders of magnitude lower than any other choices available today in the composite arena. A lower priced core would make a large scale projects, heretofore cost prohibitive, a reality. Also, it would provide a volume commercial application for kenaf inner fiber, important for an industry focused on outer "base" fibers and farmers would have a sustainable cash crop. Many thousands of cubic feet of core could be exported from the U.S. to Europe, Australia, and Asia.

**TITLE OF RESEARCH:** INNOVATIVE ENZYMATIC REACTOR FOR PRODUCTION OF ALTERNATIVE FUELS

**COMPANY:** MONTEC RESEARCH  
1901 SOUTH FRANKLIN  
BUTTE, MT 59701

**PRINCIPAL INVESTIGATOR:** MR. STEVEN MCGRATH

**TOPIC AREA:** INDUSTRIAL APPLICATIONS

**GRANTED AMOUNT:** \$80,000/6 MONTHS

The Phase I project will demonstrate the feasibility of an innovative reactor for the production of alternative fuels with complete conversion of free fatty acids coupled with continuous recovery of products. Key features of the continuous process for the conversion of agricultural by-products to biodiesel are: Ability to utilize low cost agricultural by-products such as vegetable oils, tallow, and yellow grease to develop a value-added industrial biodiesel production process; Continuous recovery of products to eliminate end-product inhibition for the process and shift thermodynamic equilibrium to the product direction. The novel reactor will be used to address all the major limitations of the contemporary processes enabling cost competitive production of biodiesel, without generation of any waste by-products. Biodiesel is a nontoxic, biodegradable replacement for petroleum diesel. Currently, biodiesel is produced by a process called transesterification. The vegetable oil or animal fat is first filtered, then preprocessed with alkali to remove free fatty acids. It is then mixed with an alcohol (usually methanol) and a catalyst (usually sodium or potassium hydroxide). The oils' tri-glycerides react to form esters and glycerol, that are then separated from each other and purified. This is an expensive, complex process. The novel process that will result out of this Phase I project circumvent these issues and provides for a process that produces a high quality biodiesel and glycerol product independent of the feedstock composition or moisture content. No waste products are produced in the one-step process. This project will result in a step change in technology development enabling the low cost production of biodiesel from a variety of feedstocks including vegetable oils, (soya, rape and canola), tallows and yellow grease.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The USA produces 20 billion pounds of plant oils and 11 billion pounds of animal fats and recycled greases annually. The animal fats represent a potential biodiesel output of 1.5 billion gallons compared to the estimated production of 230 million gallons in 2000. Based on developing a truly competitive technology that can cost effectively convert fats to biodiesel, it will be possible to capture a substantial portion of this untapped market. Concerns related to feeding animal by-products (already banned in Europe) will increase the incentive to convert fats to biodiesel and further strengthen the market potential of the technology. Conservatively estimating the potential as 20% market share after 5 years, will give access to a total of 300 million gallons of biodiesel with a value of roughly \$300 million per annum at current fuel prices.



**TITLE OF RESEARCH:** CHEMICALLY ACTIVE LABEL FOR THE VISUAL ESTIMATION OF FRUIT RIPENESS

**COMPANY:** ADA TECHNOLOGIES, INC.  
8100 SHAFFER PARKWAY, SUITE 130  
LITTLETON, CO 80127-4107

**PRINCIPAL INVESTIGATOR:** DR. JOHN S. LOVELL

**TOPIC AREA:** MARKETING AND TRADE

**GRANTED AMOUNT:** \$79,997/6 MONTHS

The U.S. pear industry is facing the challenge of marketing an increasing harvest of winter pears—one that will soon exceed 20 million bushels. Agricultural specialists have long recognized that the biggest obstacle to the successful marketing of the winter pears is the fact that the consumers are generally ignorant of the requirements to ripen fruit and are often disappointed with their experience with pears. There are similar problems with other produce, such as melons. Given that most fruit is now labeled, ADA Technologies proposes to develop a non-toxic, chemically active label that will progressively change color in response to the ripening of fruit. As it is currently envisioned, the label will respond to the increasing flux of the plant hormone, ethylene, as the fruit approaches the climacteric, marking the on-set of ripening. The consumer will be able to quickly tell whether the fruit is near-ripe, ripe, or over-ripe. This approach is applicable to a wide range of different fruits, but, for the proof-of-concept work in Phase I, ADA proposes to use d'Anjou winter pears. Phase I tasks will be focused upon demonstrating the feasibility of designing and producing safe, low-cost labels that will provide the target performance.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Phase I success will set the stage for Phase II optimization/prototype demonstration with a range of pear cultivars as the next step toward Phase III commercialization. This label will benefit consumers, with a visual indication of the edibility of the fruit; growers, will benefit from a larger demand; and retailers, will benefit from better inventory control and from less wastage from excessive handling and bruising. The success that is anticipated with pears under this project could then be applied to other produce, such as melons, nectarines, plums and papayas. The potential worldwide market could reach many billions of units/year.

**TITLE OF RESEARCH:** DEVELOPMENT OF INNOVATIVE REAL-TIME/NEAR REAL-TIME INFORMATION SYSTEMS

**COMPANY:** CYTEC CORPORATION  
736 S. PRESIDENT STREET  
JACKSON, MS 39201

**PRINCIPAL INVESTIGATOR:** MR. WALTER GRIFFIN

**TOPIC AREA:** MARKETING AND TRADE

**GRANTED AMOUNT:** \$80,000/6 MONTHS

The United States Department of Agriculture (USDA) can benefit from development of Real-time/Near Real-time Information Systems that improve operational efficiencies of tasks that involve labor intensive activities and/or cannot be accomplished using traditional methods. Cytec offers a comprehensive solution to support USDA requirements by completing a high-quality research and development (R&D) capability that promotes advanced concepts related to Automatic Identification Technology (AIT) opportunities. The Cytec R&D initiatives are expected to lead to significant public benefit when the research is completed. Cytec envisions a Cotton Inventory Management System (CIMS) to provide tracking and data storage for warehoused cotton bales. Development of CIMS will be based on tracking and data storage needs that exist today, while adding the advancements that are a part of AIT. The utilized AIT components will consist of bar coding technology, contact memory button, radio frequency data collection (RFDC) and handheld pen based personal digital assistant (PDA) such as Palm Pilot/Handspring, and PocketPC (iPAQ, etc.). The development phase will address two specific issues: 1) the precise location of each cotton bale stored within the warehouse and 2) the detailed data (USDA rating, fiber length, whiteness, etc.) associated with each cotton bale.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

Utilization of AIT and the development of CIMS will produce opportunities that benefit improved efficiencies in cotton processing from the point of agricultural collection and tracking it through transportation to the mill where it becomes a useable product. A business case will be developed that includes affixing a CIMS device to each cotton bale containing the detailed data information. Each attached device, consisting of a button memory device and RFID technology, will provide for the precision tracking of the bale. Each device will have wireless connectivity allowing for remote reading/writing of the detailed data information to each bale.

**TITLE OF RESEARCH:** ALASKA FIBER MILL TO PROMOTE RURAL DEVELOPMENT  
AND SUSTAINABLE AGRICULTURE

**COMPANY:** FUNNY RIVER RANCH (SUBSIDIARY OF FUNNY RIVER  
SAFETY, LLC)  
P.O. BOX 3157  
SOLDOTNA, AK 99669

**PRINCIPAL INVESTIGATOR:** MS. DIANE M. CAMPBELL

**TOPIC AREA:** MARKETING AND TRADE

**GRANTED AMOUNT:** \$9,243/6 MONTHS

Implementation of a full service fiber mill in the State of Alaska would greatly benefit rural ranches and farms by offering value-added processing in state, thereby allowing ranches and farms to expand their fleece production. All fiber producers are currently required to process their fiber themselves or send it out of state and sometimes out of the country to obtain end products for sale, which can be cost prohibitive to the small breeder. There are no full service mills currently in operation in the State. Income would be generated in rural communities from the cottage industry of production knitters and fiber artists contracted by the mill to create end products.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

A feasibility study will be conducted to determine the market potential for fiber producers and an outlet for end product sales. It is anticipated a mill will be self-supporting within the first two years of operation. In-state processing of fiber will give producers the ability to expand their operations and increase their number of livestock by creating an end product market.

**TITLE OF RESEARCH:** MARKET SEGMENTATION ASSESSMENT FOR PELLETIZED STRAW TURFGRASS MULCH PRODUCTS

**COMPANY:** PELLETIZED STRAW, LLC  
3676 W 9000 N ROAD  
MANTENO, IL 60950

**PRINCIPAL INVESTIGATOR:** MR. EDWARD LEE

**TOPIC AREA:** MARKETING AND TRADE

**GRANTED AMOUNT:** \$79,938/6 MONTHS

This project identifies and investigates market characteristics of commercial turfgrass segments and their potential use of mulch products. The turfgrass mulch marketplace has been dominated by dry-applied and unprocessed straw. A new pelletized straw mulch is currently being developed. This new mulch preliminarily appears superior to conventional straw mulches, but faces a very challenging obstacle in market penetration. The basis for this obstacle appears to be a lack of consumer appreciation for the significant differences between these two different mulch products. Preliminary research indicates that the new pelletized straw mulch forms a more effective, mulch matrix for conservation of soil moisture. Market research and a strong marketing plan are as important as product development, in terms of this business venture being successful. The segmentation of the potential market will be identified, followed by the quantification of the potential size of each market segment in terms of physical volume and revenue. This information will be used to help bring to market product currently being researched under a Phase I SBIR Project (Industrial Applications) in FY 2001.

#### **ANTICIPATED RESULTS/POTENTIAL COMMERCIAL APPLICATIONS OF RESEARCH**

The results of this research are expected to indicate the potential market size and price points for pelletized straw mulch in various market segments within the commercial and residential turfgrass industry. Viable market segments are expected to be identified in State and Federal Transportation Departments, School and Park Districts for play fields and sports fields, commercial landscape architects, and mass merchandisers.